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Bronx-Whitestone Bridge

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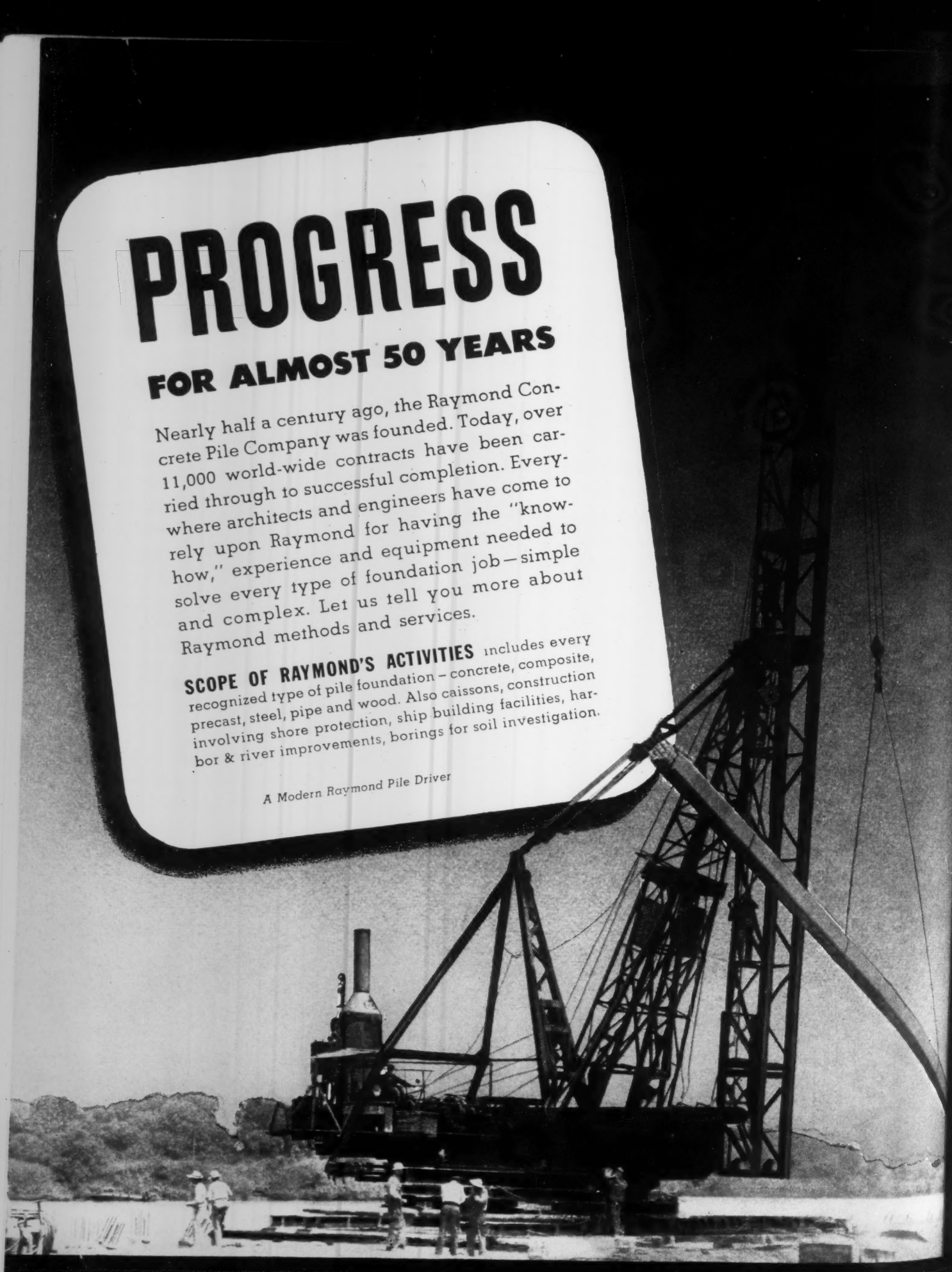

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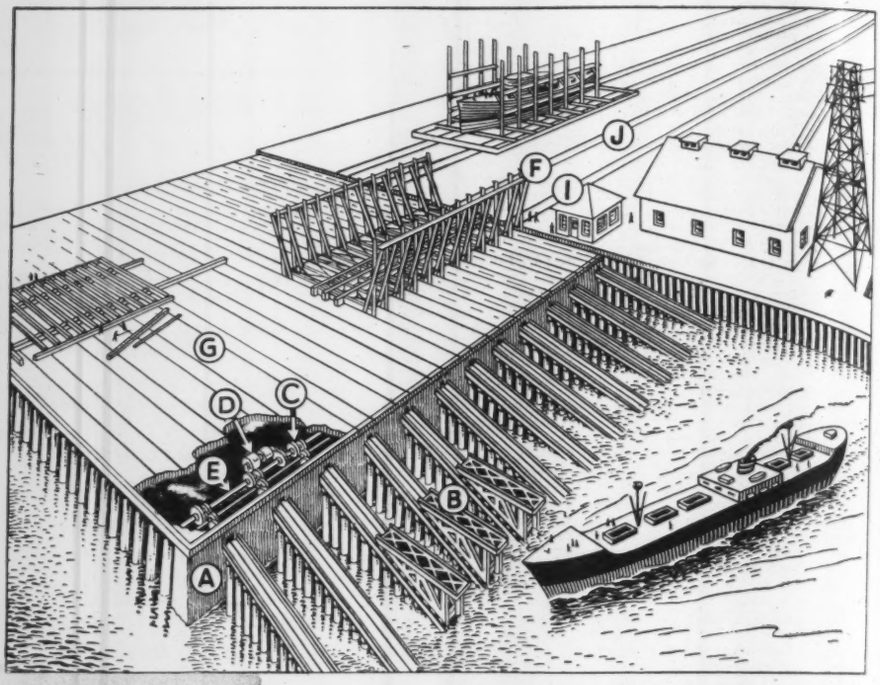
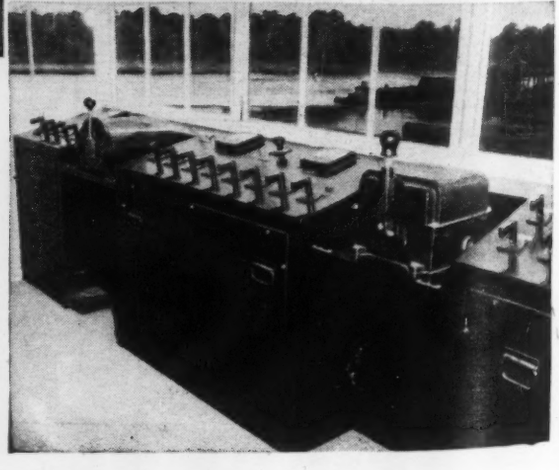


Diagram of shipyard: **(A)** is the headwall behind which is the main haulage shaft **(E)**, powered by 200-hp G-E motors **(D)**. **(C)** is one of the winches used to take up slack on the cradles **(B)**. The shunt area **(G)** has rails for moving the transfer carriages **(F)** in line with rails in the repair section **(J)**. Operator in the control house **(I)** handles entire job through directions received by telephone.

View of shipyard looking across shunt area. Ship is in transfer carriage on cradles raised to shunt level.

Here, two carriages are in use. Piling reaches 330 feet into the river on a 17 per-cent grade.

Control bench with winch control handles, and master switch for haulage shaft at left. Control for shunt area hauling is at right.



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Science and Engineering

Engineer's Scientific Approach Needed to Guide Man's Destiny

By BORIS A. BAKHMETEFF, HON. M. ASCE
CHAIRMAN, ENGINEERS JOINT COUNCIL PANEL ON A NATIONAL RESEARCH FOUNDATION, NEW YORK, N.Y.

DEPENDENT though it is on engineers and scientists, mankind has ever depreciated the well-intended advice of such intellectuals. This situation is largely the engineer's own fault, says Dr. Bakhmeteff. And, to bring about a new respect for their well-qualified opinions, the scientist and the engineer must cast off apathy in relating their developments to human problems and present energetically fact-substantiated answers to current questions. This theme was developed by Dr. Bakhmeteff in an address before the American Society of Civil Engineers at its recent Annual Meeting in New York.

EVERYONE is "for science," just as everyone is "against sin." Indeed, the title of this dissertation sounds like one of those academic subjects that call for a stream of obvious and boring banalities. Conditions in our world, however, are anything but academic. The historic juncture is such that science in general, and engineering science in particular, are very practical issues of pressing, urgent importance. The entire nation, during the last year, has visibly become research and science conscious. There is no better evidence of this than all the bills on "science legislation" pending in Congress—with the prospect of enactment in the near future of a National Science Foundation.

These unprecedented happenings are directly linked to the lessons of the war. Modern warfare is a battle between scientists. Destiny is on the side of those who excel in production and who out-smart the enemy in defensive and offensive weapons. Fortunately for us, in the recent gigantic trial this country was on the winning side. The surge of patriotic fervor was buttressed by miraculous achievement in industrial conversion and production. And back of such effort was the silent and perseverant labor of thousands of engineers and scientists who lent to the surging might of American arms their creative genius and inventiveness.

RESOURCES FOR LEADERSHIP

The anxieties and experiences of those recent days left an indelible impression on the government and the public mind. The American people clearly realize that to maintain the eminent position into which the United States has been thrust as a result of the war, this country must exercise eternal vigilance. Hence the stream of legislative measures aiming at research in the realms of national defense laid before Congress in the earlier part of last year. But military implementation is only a part of the issue. The position of world leadership in which this country finds itself, embraces all aspects of life—economic, political, cultural, spiritual. This leadership America is obliged to accept and to maintain. History does not forgive the shirker. The nation accordingly must aim for the highest standards in national health, economic welfare, and morale. All these heights are unattainable without the aid of science.

The new realization rings clearly in the words of President Truman: "Progress in scientific research and development is an indispensable condition in the future welfare and security of the nation. . . . No nation can maintain a position of leadership in the world of today unless it develops to the full its scientific and technological resources."

It is this realization that is prompting Congress to establish a National Science Foundation, devoted to basic scientific research and development. The magnitude and urgency of the problem are such that science and research can no longer rely upon private philanthropy for support. Hence the readiness, unprecedented in the past, for the generous appropriation of federal funds.

BASIC AND APPLIED RESEARCH

In viewing the forthcoming era of scientific expansion, one must clearly distinguish between basic scientific research, dealing with the fundamentals of natural sciences, and applied or technological research. Applied research, of course, is the natural field of the engineer. In this field America has yielded to no one, having consistently displayed unparalleled ingenuity in technology and industrial organization.

On the other hand, the situation with regard to basic scientific research is very different. In this field, generally speaking, this country did not keep pace with Europe, but depended to a great extent on inspiration and initiative coming from overseas. The ravages and dislocations of the war have violently disrupted the scientific balance existing in the past. This creates a problem of utmost gravity and pressing urgency. Under no less a threat than that of losing the primacy gained at such terrific sacrifice, the United States must bring her own scientific research to a new high level.

In no branch of fundamental research is the void more acute and pressing than in the realm of basic engineering science. This brings up a topic of vital importance, and one which for some reason or other is scarcely understood by the public or even by many

engineers. One broadly accepts the fact that the natural sciences furnish the basis for technology. But many fail to realize that over the last few decades a vast field of basic science has become the specific field of present-day engineering. In civil engineering, elastic theory is rapidly spreading in the realm of structural analysis; structures are appraised in terms of stability, eventually under the impact of aerodynamic agencies. Fluid mechanics, with emphasis on turbulence, separation, cavitation, and other novel notions unknown to the hydraulician a few decades ago, are indispensable to a proper grasp of the eventual behavior of water in hydraulic structures, its possible destructive effect, and such infinitely complex but vitally important phenomena as suspension and bed load. Fluid seepage and the mechanical behavior of soil masses direct the present-day reasoning of the foundation engineer. One may summarize by stating that the unprecedented wave of progress which swept the world over the last half century has evolved what may properly be called a scientifically oriented technology and has moulded, as its moving spirit, the novel type of scientifically minded engineer.

PUBLIC'S LACK OF UNDERSTANDING

To say the least, public opinion is scarcely aware of the existence and importance of engineering science. It is indeed an amazing fact that in the course of the testimony on science legislation, which continued for weeks before a Senate subcommittee, and also in the earlier reports by various scientific committees which served as the basis for the proposed bills, fundamental research in the engineering sciences was not mentioned and the vital urgency of sponsoring basic engineering sciences was totally overlooked, until set forth in energetic terms by the panel of representatives of the major engineering societies appointed by action of the Engineers Joint Council, as well as by the representatives of the Engineering College Research Association.

A most difficult problem is that of "selling" fundamental research in engineering sciences to government and public bodies, to industrial concerns, and to private benefactors. Indeed it is easy to get all the necessary enthusiasm for an astronomical observatory, for atomic research, or for social sciences. But thus far engineering does not command interest or response, and that notwithstanding the fact that most of the present "endowments" and "funds" arose out of successful technological enterprises. The situation must be faced realistically and with all possible candor. The big issue is to raise the position of engineering science in the eyes of the public in general. Herein lies a most difficult struggle against ignorance, prejudice, and lack of understanding. As a possible illustration, memory reverts to an amusing experience. A group of engineering scientists of world-wide fame gathered for their last prewar convention on the beautiful campus of a leading preparatory school. A most affable and hospitable host, the headmaster, addressing words of welcome to the gathered engineers and scientists, referred to his particular delight in seeing so many eminent engineering specialists, who might be helpful in solving a vexatious problem, namely, the imperfections of the school's plumbing system.

ALL PLUMBERS?

This experience is humorous but in all seriousness there will be many such "plumbing" notions to overcome. This attitude of the general public toward basic engineering science is but a partial reflection of the glaring disproportion between the role which the engineer plays in providing and maintaining the basis of modern civilization, and the influence which he exercises over the shaping and directing of public affairs. His chores and labors are taken for granted. His opinions are not asked for. In fact, by comparison with the lawyer, the newspaperman, the social worker, and the politician, the engineer counts for little in framing and managing public life. An amazing illustration is the recent conference (UNO) at San Francisco. Every professional and pressure group was represented in an "advisory capacity." Noticeably absent from the long list were engineers.

EXPRESSION NEEDED

To a great extent, this sad and altogether anomalous situation of the American engineer is his own fault. The engineer in this country has kept silent. He has not expressed his views and opinions when matters of vital importance were being decided. In this the engineer has done an obvious injustice to his profession. But first and most important he has done a disservice to the nation as a whole. We live in a world of incertitude, confusion, and change. In the momentous events which have marked the last decades, values and traditions which used to maintain the stability and integrity of life have been swept away. Humanity is groping for patterns and means to reaffirm the security of human existence and the continuity of civilization. In such troubled times, people yearn for sober, courageous, and unbiased judgment springing from a realistic appraisal of factual truths, and capable of solutions based on common sense and fair play.

By his upbringing and life training the engineer is essentially a realist, one apprenticed to deal with "things" as against meaningless "words," essentially a "builder" with a natural aversion to "tearing down" without knowing how to replace. It is time for the engineer to arise and assert himself, to make his voice heard and felt throughout the nation, and to exercise his moderating influence for the betterment of things human. This is no call for politics or partisanship—just the contrary. In fact the very reason why the engineer is so well qualified to speak the truth, militates against him. This was well expressed ages ago by Plato, who once said, "Everything that deceives may be said to enchant." The engineer, on the other hand, should not get discouraged by the possible lack of immediate public acclaim. His judgment cannot fail to command proper attention. As Emerson expresses it, "Nothing astonishes men so much as common sense and plain dealing."

THROW ASIDE INDIFFERANCE

How is the engineer to assert himself? First and primarily by throwing off his apathy, by standing up and giving his plain and soberly weighed answer to critical current questions. The proper way has been shown by the Engineers Joint Council in its report on the postwar handling of German industry and economics. Civil engineers should take particular pride in the splendid leadership displayed in this connection by their own Past-President Malcolm Pirnie. Another more recent example is the initiative of the Joint Council in arranging for the engineers' testimony on science legislation in Washington. Were it not for such testimony by the engineering panel and by the Engineering College Research Association, it is doubtful whether the forthcoming legislation would recognize engineering science in its research plans. All these fortunate beginnings should be carried forward. The experience and special aptitude of the engineer should be made to count properly in the councils of the nation. Here, then, is an urgent need for comprehensive, realistic, and practical answers.

Additional Stiffening of Bronx-Whitestone Bridge

Provision Also Made for Greater Traffic Capacity

By O. H. AMMANN, M. ASCE
CONSULTING ENGINEER, NEW YORK, N.Y.

AS completed in 1939, the Bronx-Whitestone Bridge in New York City embodied several innovations in design. Chief among these was the adoption of relatively flexible plate stiffening girders in a long-span suspension bridge. The depth-to-span ratio of these girders was 1:209, making it at that time the most slender of comparable structures, except the heavier and longer George Washington Bridge. Studies carried out during the following year showed that, although no danger of structural failure existed, additional stiffness was desirable. Therefore the alterations here described by Mr. Ammann have been planned.

PLANS for the stiffening of the Bronx-Whitestone Bridge and the widening of its roadways were prepared by the Triborough Bridge Authority in 1941, but construction had to be deferred on account of war priorities on materials. This work will now be carried out.

The original design of this bridge, developed by the staff of the Triborough Bridge Authority under the writer's direction as chief engineer in 1935, provided for a suspension bridge with a central span of 2,300 ft and two side spans of 735 ft each. In place of the conventional stiffening trusses previously used in modern suspension bridges of long span, except the George Washington Bridge, stiffening plate girders of 12-ft depth were adopted. Such shallow, comparatively flexible stiffening girders appeared desirable because they permitted a saving of two million dollars compared to conventional stiffening trusses, and because they tended to enhance the appearance of the structure.

It was believed that, in spite of this relatively great flexibility, the bridge would still be sufficiently rigid under actual conditions. In this respect consideration was given primarily to rigidity under moving traffic. Possible oscillations under dynamic wind action were not in question.

TREND TOWARD MORE SLENDER SPANS

This belief appeared justified by prior trends in the design of highway suspension bridges with long spans. The Detroit River Bridge, completed in 1929 with a span of 1,850 ft, established a new record for relatively shallow stiffening trusses (1/84 of the span). It proved amply rigid under traffic and as far as was known had not experienced motions under wind action. The George Washington Bridge, of 3,500-ft span, was designed with shallow stiffening trusses (1/120 of the span) in its ultimate two-deck condition, but was opened to traffic in 1931 with a single deck and without any stiffening trusses. It also had exhibited ample rigidity under all traffic conditions and was not known to oscillate under wind action. This rigidity was attributed primarily to its very great weight. The Golden Gate Bridge, with a span of 4,200 ft and stiffening trusses of a depth-to-span ratio of 1/168, was then nearing completion. The design of the ill-fated Tacoma Narrows Bridge had not yet been developed.

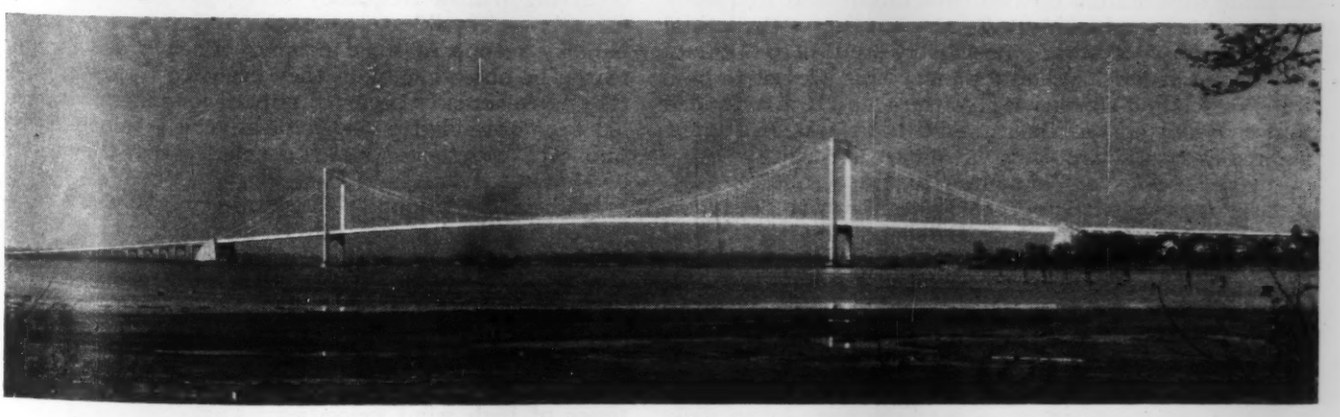
The Bronx-Whitestone Bridge has proved amply rigid under traffic, no oscillating motions, except the local vibrations observable on any bridge under the passing of modern, heavy, high-speed vehicles, having been observed.

During the development of the final plans, certain modifications in the design were made which tended further to reduce the rigidity, although even without them the bridge would probably have fallen short of the necessary degree of rigidity against wind action. These changes embraced the substitution of a light $4^1/_2$-in. concrete-filled steel-grid floor-slab in place of the original heavy concrete slab, an increase in the sag of the cables in the center span, and a decrease in the depth of the stiffening girders from 12 to 11 ft.

The design as carried out was described by the writer in an article in CIVIL ENGINEERING for April 1939.

STEPS TO CHECK OBSERVED OSCILLATIONS

Oscillations under the action of wind developed first in March 1939, during construction, when the steel forms for the concrete slab began to offer a solid horizontal area exposed to wind action. The vertical motions of the center span were characteristically wavelike, mostly with a single node at the center and with double ampli-



SIMPLICITY AND SLENDERNESS ARE CHARACTERISTICS OF BRONX-WHITESTONE BRIDGE

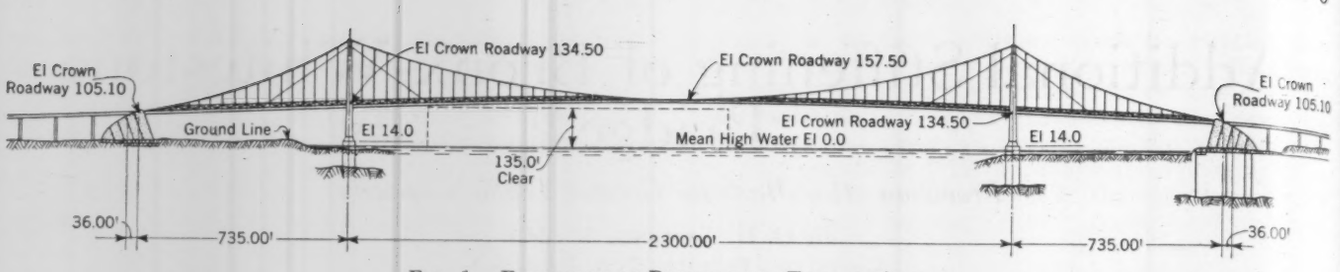


FIG. 1. ELEVATION OF BRIDGE WITH TRUSSES ADDED

tudes of between 2 and 3 ft at the quarter points. They were accompanied by longitudinal motions of the floor as observed at the towers.

The wind which produced these early motions came almost invariably from a northwesterly direction, at an angle of 30° to 45° to the axis of the bridge. At the same time strong upward wind currents were noticed outside of and through openings in the bridge floor. The motions occurred rather frequently and under relatively moderate wind velocities. These observations led at that time to the conclusion that the motions were induced by longitudinal wind pressure acting from below on the pockets formed by the floor structure, the latter being freely suspended from the cables with practically no restraint against longitudinal swinging motion.

Subsequent developments have established beyond question that the predominantly vertical oscillating motions are induced by a more or less horizontal wind stream acting on the elastically suspended structure, and are possible because of the inadequate vertical stiffness of the structure.

When the motions appeared, it was expected that the increased dead weight due to the placing of the floor concrete would dampen them, but this proved to have little effect. Immediate steps were taken to check the motions, and during the following two years a number of devices were successively installed and improved upon to stiffen the structure.

These installations were described briefly in an article published in *Engineering News-Record* for December 5, 1940. They have proved partially, but not entirely, effective. They rendered the structure much less sensitive to wind action, in that appreciable or objectionable motions have occurred only at rare intervals and under higher wind velocities. The maximum observed double amplitudes remained, with a magnitude of 2 to 3 ft.

OSCILLATIONS MEASURED

Early in 1940 it was decided to undertake periodic measurements of the oscillations in order to obtain more accurate information on their magnitude and frequency of occurrence, and incidentally also to observe the lateral movements. Ways and means were studied to obtain a continuous record of the motions. This proved to be a complicated and expensive procedure, and it was decided that frequent periodic measurements by transit, supplemented as far as possible by extra measurements at times of severe motions, would answer the purpose.

A transit was set up on the Queens tower below the floor, and targets erected at the center and at the near quarter-point of the center span. Since observations had indicated that the severest motions of the center span were one-node motions with maximum amplitudes at or near the quarter points, the regular periodic readings were limited to the quarter point. The lateral movements were observed at the center of the center span.

With few exceptions, three readings were taken daily at 1 a.m., 9 a.m., and 5 p.m. Additional observations were made on several occasions when severe motions occurred. Prior to September 22, 1941, the temperature, wind direction, and wind velocity were obtained from the U.S. Weather Bureau and were those recorded at its station in the Whitehall Building at the Battery. Thereafter observations were made by meteorological instruments placed near the bridge site, except during a few short intervals.

It was not expected that these wind records would permit the establishment of a close and consistent relationship between wind action and the motions of the bridge, but it was desirable to know to what extent the severity of the motions depended upon the wind velocity in the vicinity. The results of the observations may be summarized as follows:

Out of a total of approximately 5,500 observations for vertical motions, only 3% showed double amplitudes in excess of 5 in. Double amplitudes over 10 in., and up to 20 in., were observed on the average of about six days each year. Double amplitudes of more than 20 in., up to the observed maximum of $2^1/_2$ ft, occurred on four days, or, on the average, less frequently than once a year.

EFFECT OF WIND ON OSCILLATIONS

The observations indicate no consistent relationship between the amplitudes of the vertical oscillations and either the direction or the velocity of the wind. While most of the higher amplitudes developed at wind velocities of 30 miles an hour and more, the amplitudes remained within 10 in. at the great majority of times when relatively high wind velocities occurred—as high as 60, 70, and 81 miles, the latter during the severe hurricane of September 14, 1944.

Most of the higher amplitudes occurred under northwest and west winds, undoubtedly because that is the prevailing direction of the severer storms. The axis of the bridge lies north-northwest about 30° from north. A few amplitudes over 10 in. were observed under south winds.

Vertical double amplitudes appreciably over 12 in., occurring with a frequency of 7 sec and less, are sufficiently perceptible to cause discomfort and possibly a panicky feeling in some people. They would for that reason be objectionable if they occurred frequently. As they have actually occurred only at long intervals, there has been occasion for very little adverse comment by the public. Nevertheless it was concluded that they should be eliminated.

In their effect upon the structure, the most severe observed amplitudes are entirely harmless, and would be so even if they occurred very frequently. The greatest deflections or single amplitudes in the one-node motion are only about 1/800 of the half-span, or less than one-sixth of the safe deflection under maximum live load.

Of the observed lateral deflections, 99.8% were 3 in. and less, and a large proportion of these occurred at times of high wind velocities. Deflections over 3 in., and up to a maximum of 8 in., were observed during

only 11—or 2%—of all observations. In most cases the larger deflections coincided with high wind velocities. This leads to the conclusion that lateral deflections do not exceed a fraction of the theoretical deflections which would be produced by static wind pressure corresponding to the observed wind velocity, and remain well within the safe maximum deflection of $8^1/_2$ ft for which the bridge was designed.

No instrumental observations were made of torsional motions of the bridge floor because visual observations had never indicated appreciable motions of this kind. During all observed major vertical oscillations under wind, the two cables moved practically in unison.

STIFFENING OF TRUSSES

Extensive studies for the further stiffening of the bridge, and incidentally for the widening of the roadway on the bridge and approaches, were made in 1941. In these studies the writer collaborated with Shortridge Hardesty, M. ASCE, and Madigan-Hyland, acting as consulting engineers to the Triborough Bridge Authority. Madigan-Hyland also prepared the contract plans for this work.

The adopted scheme for stiffening the bridge consists of the addition of a stiffening-truss top-chord and web members above and in the plane of each girder. The latter forms the bottom chord of the truss and participates in resisting bending moments and shears. A uniform depth of 25 ft from the bottom of the girder to the top of the truss was adopted, except for the short central portion of the center span, where the top chord will run parallel to and underneath the cable (Fig. 1). This depth, representing about 1/92 of the center span, was considered ample to provide adequate stiffness, and on the other hand was found not to involve excessive stresses under the severest possible combinations of live load, temperature changes, and wind.

The truss top-chord is stiffened laterally by welded brackets extending above the floor beams (Fig. 2). The existing rope suspenders and diagonal stay-ropes will remain undisturbed. They will pass through open-slotted holes in the webs and cover-plates of the truss members to permit free motion. To prevent damage by possible rubbing of the ropes against the truss members, the ropes are to be covered at the intersections by No. 12 galvanized wire sizing.

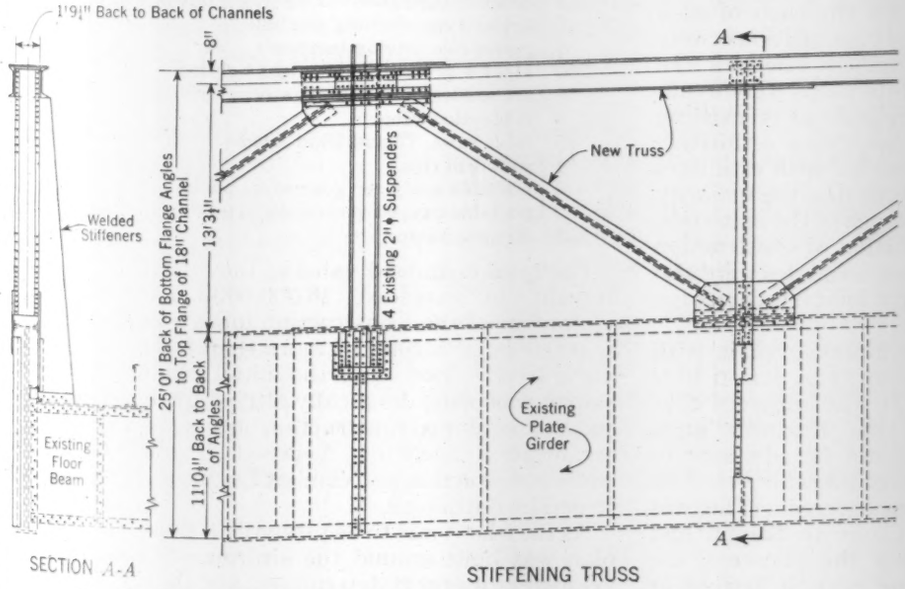


FIG. 2. PANEL OF A STIFFENING TRUSS ATTACHED TO PRESENT GIRDER

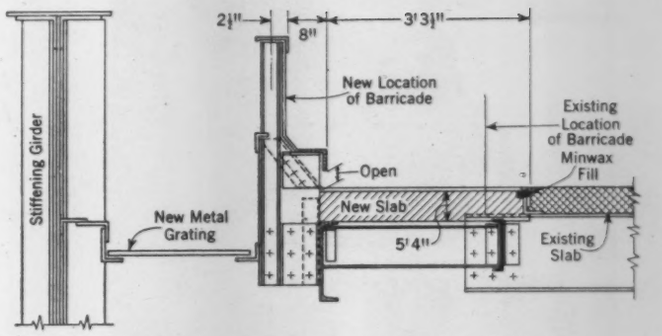


FIG. 3. SECTION THROUGH WIDENED ROADWAY SLAB, SHOWING NEW LOCATION OF BARRICADE

The addition of the truss members has the effect of increasing the maximum moment of inertia per girder or truss from the original 2,650 in.² ft² to 19,850 in.² ft², or to about $7^1/_2$ times the original value. Expressed in terms of resistance of the combined cable and truss system to deflection under a uniform load, the original rigidity will be increased about 60%. The resulting degree of stiffness will be close to that of several existing suspension bridges which are not known to have noticeably oscillated under wind action.

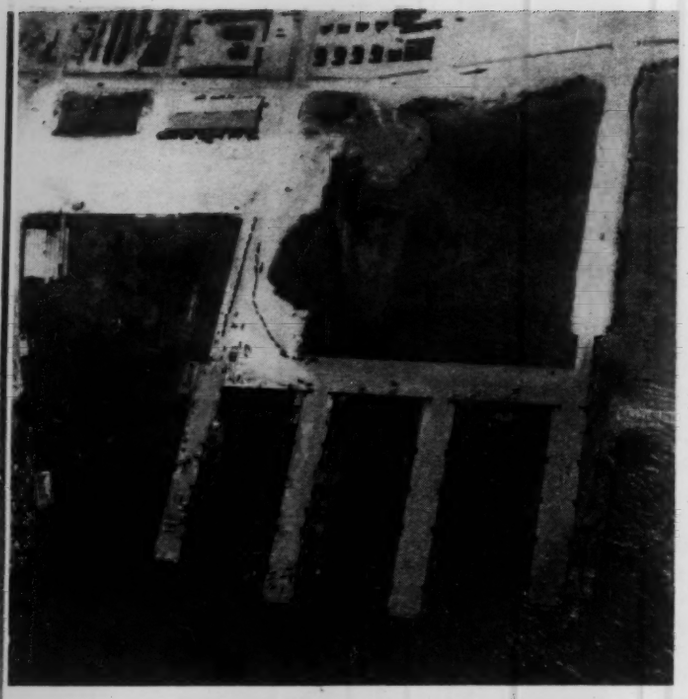
APPEARANCE NOT MARRED

While the truss members will undoubtedly detract somewhat from the extreme simplicity of the original design, with its plain shallow girders, they will not be sufficiently conspicuous to mar the graceful appearance.

The bridge was built to accommodate four lanes of mixed vehicular traffic, two lanes in each direction and two pedestrian walks. However, an extraordinary width of 28 ft 9 in. between curbs was adopted for each roadway so as to make it possible for passenger autos during peak-hour traffic to move comfortably in three lanes. Already in 1941 the volume of traffic, and particularly truck traffic, had reached such an unexpected volume that it appeared desirable to widen the two roadways to a full three-lane capacity for mixed traffic.

Studies indicated that this was practicable by eliminating the two pedestrian walks, at relatively small expense, and within the safe carrying capacity of the suspenders, cables, towers, and anchorages. Each roadway will be widened by 3 ft 3 in., or to 32 ft between tops of curbs. Details of widening of the floor structure on the bridge proper are shown in Fig. 3. The work consists essentially of moving outward the two steel barricades which now separate the roadways from the pedestrian walks, and of the construction of two new strips of concrete slabs $6^1/_2$ ft wide. Incidentally provision is made in the plans for a possible future resurfacing of the roadway slabs with a $1^1/_2$-in. bituminous top.

The original design dead-load of 11,000 lb per ft of bridge is increased by these alterations to 12,600 lb, or by 14.5%. A contract for carrying out the construction work has been awarded to the Woodcrest Construction Company for an estimated contract price of $1,312,000.



PONTOON FINGER PIERS ON "ABLE," WITH PIER "BAKER" AT LEFT Cargo Areas in Background

Building Saipan

Vast Program Included Airfields, Piers, Repair Facilities, Water Supply, Hospitals, and Roads

By JAMES C. HOWLAND, JUN. ASCE
MAJOR, CORPS OF ENGINEERS, U.S. ARMY

SOME five months before Marine and Army troops stormed ashore on Saipan, Army Engineers were at work preparing plans and assembling materials and equipment for the construction necessary on that island. The first echelon of Army Construction Engineers waded ashore and their first heavy equipment was hauled across the shell-swept beach on the heels of the assault forces at "D + 5." This continued until about 16,000 construction troops and their equipment were ashore. The months of preparation on which the success of the work depended, as well as the construction operations themselves, are here described by Major Howland. Although construction of each base in the Pacific presented unique problems, this paper gives a general picture of the amount and complexity of the work required at such bases.

INTELLIGENCE information on the Island of Saipan was meager. Preliminary studies were based on old German maps, information gleaned from official records of the Japanese Diet, early weather reports and information known about Guam, 125 miles to the south. The first up-to-date maps were made from oblique photographs taken by carrier planes in the strikes of February 23, 1944, four months before the landing. On April 18, 1944, the first B-24 strike from our newly won bases in the Marshalls was made. From this strike a series of vertical pictures giving complete coverage of the island was obtained, resulting in an excellent map. At this time there also became available captured Japanese hydrographic charts for Tanapag Harbor. These were found to be accurate, and were used for planning, design, and construction until hydrographic surveys could be made.

Another source of information of great value was the people who had lived on Guam, since the geological formations of both islands are similar. On the basis of such information, tentative locations of installations were made and types of excavation equipment selected. In February 1944, before any up-to-date maps were available, the 8,500-ft B-29 runways were laid out on existing incomplete maps and earthwork quantities estimated. On the basis of these quantities, coupled with estimates on construction of standard Army facilities, the majority of the construction machinery, and much of the materials, were ordered, and a tentative allocation of construction troops was made. Construction time estimates were also made, and succeeding phases of the military campaign were predicated on these estimates.

In ordering equipment, the machinery organic with each Engineer Construction Battalion or Aviation Battalion was of course considered. It was apparent that the organizational equipment of the Engineer units scheduled for the operation would not be adequate to complete the large construction program, and therefore additional "mission" equipment was ordered. This was shipped directly from the West Coast to Saipan and through close coordination between the planners, the supply personnel, and the mainland port, it arrived at the same time as the troops that were to use it. Some of its major items were:

No.	TYPES OF EQUIPMENT
3	central hot-mix asphalt plants, 80 to 150 tons per hr
3	150-ton-per-hr crushing and screening plants
4	25-cu-yd-per-hr rock crushers
29	3/4 to 2-yd shovels
14	3/4-yd truck-mounted cranes
14	D-7 tractors
59	D-8 tractors
54	8 to 23-cu yd Carryall scrapers
16	rooters
25	D-12 motorized road graders
13	steel-wheeled road rollers
42	315-cu-ft-per-min, or larger, air compressors
53	wagon drills
106	jackhammers, 55-lb
189	4-ton dump trucks
16	14-S concrete mixers
2	1-yd concrete pavers
1	concrete pipe plant—2,400 ft per day of 4 to 36-in.
7	ladder-type ditching machines
6	power pile-driving hammers
260	1 1/2-kw generators for night lighting
16	arc welders—300-amp, gasoline-driven
3	magnetic sweepers
45	table saws, 12 and 16-in. blades
4	well drill rigs
2	portable acetylene generating plants
2	portable oxygen generating plants
238	55-gpm pumps

The total estimated value of the "mission" equipment brought in exceeded $6,000,000. The construction equipment of the Construction units was valued at over $7,000,000, or a total of more than $13,000,000 on this single base. Soon after the initial landings, the face of Saipan was being drastically altered by one of the largest and best equipped construction outfits in the world. The organization included Aviation Engineer Battalions, Army construction and combat Engineers, and Navy Construction Battalions.

As the island was to be primarily a B-29 base, the entire plan was built around the airdromes. The harbor development was next determined, and the rest fitted in.

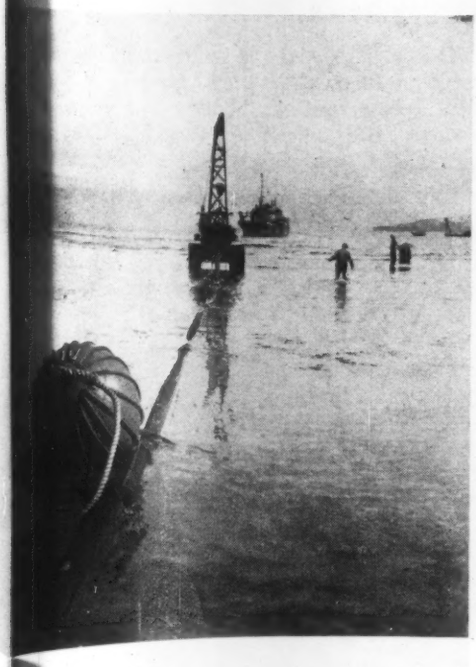
The airfields constructed on Saipan by U.S. forces are Isley Field (B-29 base), Kobler Field (transport field), Kagman Point Field (Army fighter and Navy carrier base), and Marpi Point Field (Navy carrier base). Isley Field is the major installation.

The first construction unit, an Engineer Aviation Battalion, to go ashore on Saipan landed on June 20, 1944. Despite the difficulty encountered in getting heavy equipment and personnel over the coral reef, the first detachments and equipment were repairing and extending the Japanese "Aslito Airfield" (now known as Isley Field) on D + 6. Five days later the field was operational for fighters. Concurrently, preliminary profiles were run to determine the most satisfactory azimuth for the new strips for the B-29's. The survey parties worked close to the front lines, and much of the time were subject to enemy sniper and mortar fire.

Specifications included two 8,500 by 200-ft runways (paved) with 150-ft shoulders, 186 paved hardstands, necessary paved taxiways, and two 1,900 by 300-ft paved service aprons. To these, of course, were added the airfield service and housing appurtenances. Encountered everywhere in the area, under a few inches of overburden, was a hard coral rock that required blasting. The existing terrain, wind direction, and length requirements dictated a location that called for fills up to 22 ft deep, and cuts up to 15 ft in solid coral.

The base-course coral averaged 12 in. deep over moderate and well-compacted fills, with an 18-in. depth over deep fills where compaction difficulties had been encountered. The runways drain to the shoulders and the water is carried down into a pervious coral formation underlying the field by means of drilled wells and trenches cut to the clean coral. The Japanese had drained their field into a 1,000,000-gal settling basin and, after chlorination, supplied the airfield with this water.

Coral for the subsurface was hauled from a quarry about two miles from the field, an operation which became economically feasible only after the construction of a haul road 22 ft wide, paved with asphaltic concrete, and restricted exclusively to vehicles engaged in hauling coral. Practically all work in the field was stopped for four days to build this road, but the increase in the aggregate quantities hauled overbalanced the lost time in about two days. The quarry was worked at several levels simultaneously with dozers "benching" the face and pushing the aggregate over the bench to the shovels located on the next lower level. In this way muchdrilling and shooting were eliminated. Quarry output has exceeded 19,000 cu yd per 24-hr working day.



Asphalt paving material for the airfield was produced at two central plants located at limestone quarries near the field. An interesting sidelight on one of these plants is the fact that its aggregate quarry was opened up by the explosion of a Japanese ammunition dump. Throughout the operation, small Japanese incendiary bombs were picked up and carried into the crusher.

A Completed Pontoon Pier in Use

Construction of the first of the two B-29 strips was carried on simultaneously with the use of the completed portions of the runway by a B-24 group operating against Iwo Jima and the Bonins. Seven thousand feet of this runway, 150 ft wide with coral surface, was rushed to completion for the use of the B-24's, and construction schedules were so arranged that the completion of the strip, including paving, did not hinder the operation of the heavy bombers. Some engineer equipment and personnel were lost in accidents when damaged aircraft crashed off the runway.

The first B-29 landed at Isley Field early in November 1944, and on the 24th, the first mission to Japan was flown from the single runway. Both runways were operational by December 15, six months from the day of invasion.

In the initial stages of the operation, the aviation gasoline was manhandled over the reef in drums, a slow, difficult procedure. It was not possible to keep up with the demands of the fighters covering the Guam-Tinian operations and the air evacuation planes by this method, and a temporary 6-in. vitaulic steel line was laid from the reef to the shore southwest of Charan-Kanoa. All the fuel pipe lines on the island were laid above ground because of the urgent need for aviation gasoline and the extreme difficulty of excavation in the coral rock. These lines are all of light-weight steel, vitaulic coupled pipe. The tanks are vertical steel, bolted, in two sizes, 1,000 and 10,000-bbl capacity. Four separate areas within easy hauling distance of the airfields were allocated for bomb storage, and over 300 bunkers and 18 miles of access roads were constructed.

The possibilities on Kagman Point were investigated and preliminary surveys for a fighter field were started as soon as the front lines had encompassed this area. The runway is 5,000 ft long by 150 ft wide (paved) with 75-ft shoulders on each side. The first planes landed 17 days after construction was commenced. Fighters operating from this field furnished night and day cover for the Tinian landings and the Guam operation which followed.

While the tenacious Japanese were still being blasted out of pill boxes on the piers and sunken ships in the harbor, the construction forces moved in to tackle the job of making Tanapag Harbor one of the major importing ports of the world. Construction of the piers and cargo handling areas was done by Army Engineers while Navy units and civilian USED crews under Navy direction cleared the harbor and performed the necessary offshore dredging.

Tanapag Harbor, lying on the west side of the island (Fig. 1), was, under Japanese rule, the best developed and most protected harbor in the Marianas. A 200-ft-wide channel with a minimum depth of 22 ft led into the

Launching Submerged Steel Fuel Line Over the Reef
Navy Net Tender and Engineer Anchor Barge Wait Offshore to Set Anchors and Mooring Buoys

A TYPICAL WATER SUPPLY INSTALLATION AT A SPRING
Tent Covers Portable Filtration Unit

harbor from the west, and on the east the Japanese had built three piers. The northernmost of these was an L-shaped structure built of large concrete blocks, laid up like a brick wall and backfilled with coral. This had 30 ft of water along its northern face. The outer corner had been destroyed in the battle, but it was quickly repaired by rock-filled timber cribs built of captured poles. Work was immediately commenced to extend the pier, using steel pontoons to provide a 96 by 568-ft floating structure, berthing a ship on each side.

This pontoon pier, and the five built as extensions to the other Japanese piers, were of similar construction. They were made of hollow steel cells 5 by 5 by 7 ft. Piers or barges are made by first assembling the cells into strings, using special galvanized hardware known as "jewelry" to clamp the cells between longitudinal angle irons. The floating strings, 12 cells (71 ft) long, were then fastened into pier sections, 12 cells long by 12 wide. While the pier sections were being assembled, 19 pile dolphins on 125 to 175-ft centers were being driven to act as fenders and to hold the piers in place. As the sections were completed they were floated into position and tied to the dolphins with slack cables. The sections were fastened to each other by a continuous hinge in the plane of the top surface of the pier—thus the pier was articulated every 71 ft.

This method differed from the procedure used in other locations, where the entire pier was assembled as a single unit by staggering the joints at the ends of the strings and providing no hinges. The continuous piers have broken up in storms, while the articulated piers, held in place by dolphins, have seen a year of service and no failures have occurred nor has excessive maintenance been required. Two single-lane bridges, 20 ft wide and 28 ft long, hinged at the shore end only, provide access to the floating pier.

The remaining two Japanese piers provided only shallow draft. The center pier, Pier "Baker," was next extended by a 96 by 462-ft articulated pontoon floating pier to provide two more berths. The construction of the eight remaining berths was accomplished by constructing a 100 by 900-ft steel-pile marginal pier perpendicular to the outer end of the third Japanese pier, Pier "Able," and building four floating piers out from this.

The bottom in this area was a fine alluvial silt and coral mud, and test piles driven to a depth of 100 ft encountered no hard bearing strata. The allowable load was computed by the Hiley pile formula, which takes into account the ratio of the weight of the pile hammer to the pile, because of the extremely light hammer that was available at the time the tests were run. Both lagged and unlagged piles were driven and, as a result of the test and considering the ease of construction, piles lagged with six pieces of 12 by 12, or pile butts 4 ft long, bolted to the flanges of each pile, were used. Safe loads, as computed from the Hiley formula, of 50,000 to 60,000 lb per pile were secured after 24 hours were allowed for the piles to set. Weekly levels taken on the pier since it was put in use in January 1945 have shown a maximum settlement of 0.3 ft.

In addition, two other main projects were constructed in the harbor—the Navy repair facilities and the seaplane base at Flores Point. The Navy repair and maintenance facilities were composed of a small boat repair unit, a major craft repair unit, and a net depot, all grouped around a Japanese-constructed coral spit and built principally by the "Seabees." At Flores Point, as soon as the area was cleared of the enemy, the Engineers moved in equipment to repair the Japanese seaplane ramps and parking apron, and to clear the working areas of wrecked planes. The Navy crews brought damaged flying boats in for repairs the same day. The base has since been expanded to provide extensive seaplane facilities.

Under Japanese occupation, most of the water on Saipan was supplied by rain-water catchment systems. To supply ships and the government installations in Tanapag and Garapan, the Japanese had developed several springs in the hills northeast of the harbor and had connected them into two concrete reservoirs (total capacity 300,000 gal) at 200-ft elevation, overlooking Tanapag. The only other major Japanese ground-water source was a drilled well in the south end of the island which was captured early in the battle, complete with an electric-driven deep well pump, and immediately put to work.

Before the battle for the island was over, percussion well-drilling rigs were at work exploring possible water-bearing formations. Two major basal water fields were located, one near the existing Japanese well and one at the base of Kagman Peninsula. In these fields, fresh water in the permeable rocks floats on the salty ocean

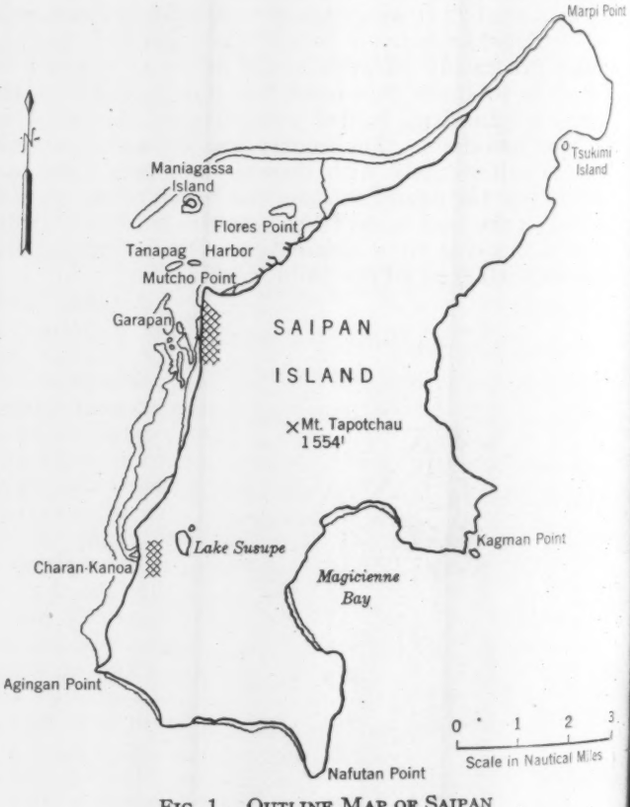


FIG. 1. OUTLINE MAP OF SAIPAN

water. A high-level field was also located on the eastern slopes of Mt. Topotchau. In each of these fields a series of 8-in. wells were drilled and developed.

Every fresh-water spring on the island was developed. This work mainly involved the construction of totally enclosed concrete collecting basins at the spring to keep out the snails, which carry liver flukes.

Water purification was of prime importance. In general, the water from the deep wells required only chlorination, while tests of the spring water disclosed gas-forming bacteria, making it necessary to install filters. The initial chlorination of the well water was accomplished by small automatic-feed hypochlorinators, adjustable from 2 to 100 gpm. Small portable 15-gpm pressure filters were used at small sources and 75-gpm trailer-mounted units were placed at the larger ones. At the one large spring, a Wallace and Tiernan Navy-procured, knock-down, semi-portable, rapid sand filter plant of 160-gpm capacity was installed. This provides for coagulation, sedimentation, filtration, and chlorination.

The well-drilling program and the island-wide geological studies indicated that the most satisfactory method of recovering the basal water would be by means of skimming tunnels. (See "Tunneling for Fresh Water on Guam," by John L. Washbourne and Norman H. Moore, in CIVIL ENGINEERING for November 1945, page 510.) For this work a civilian tunnel crew was brought in from the Hawaiian Islands. The first shaft, 100 ft deep, was sunk at Kobler Field to fresh water, which was encountered 1 ft above sea level. An 8-ft-deep, concrete-lined sump was constructed at the foot of the shaft without dewatering (to prevent drawing in salt water), and drifts 200 ft long were driven in two directions from the shaft. The floors of the drifts were set 2 ft below water level at the mouth and ran back on a plus 0.5% grade. Weirs were set in the sump walls so that the depth of skimming could be accurately controlled to prevent drawing in salt water. This well produces over 1,000 gpm with a 4-in. drawdown, and with a maximum salinity of 9 grains per gal.

A second tunnel is in the Tanapag area, where a large (1 mgd) brackish spring comes out slightly below sea level. This tunnel intercepted the water vein feeding the spring but it was found to be salty. However some water was collected by skimming. A third tunnel 1,000 yd inland is now under construction.

In designing the island-wide water system, the need for a large reservoir to supply the fleet became apparent. Behind pier "Charlie" at Tanapag the Japanese had constructed five underground fuel storage tanks. These vertical tanks had concrete gravity walls lined with steel plate and concrete bottoms. They were covered with approximately 2 ft of earth. One of these, of 3.14 million gal capacity, had never been in service. As it was only slightly damaged, it was repaired and used for water storage. The other large tanks were burned out, but one—an 8.5-million-gal tank which had held fuel oil—was rebuilt by guniting the walls and covering with a wood roof.

The present road system on Saipan consists of approximately 275 miles of coral surfaced and asphaltic concrete roads, compared to some 50 miles of roads on the island under Japanese rule. These figures, however, tell only a small part of the story, since many of the Japanese roads were little more than one-way oxcart trails, and the American roads are modern two-, three- and four-lane highways built to high standards. The first roads were built in the rainy season and it was found that an entirely new road could be constructed in less time than it took to improve a Japanese road. Therefore traffic was kept on the old road until the new road had been compacted and graded to drain. The coral used for road building serves admirably even in wet weather as long as it is well drained, but once ruts and holes develop and water is allowed to stand, it disintegrates almost immediately under traffic.

TANAPAG HARBOR, SHOWING PONTOON EXTENSIONS TO PIERS "CHARLIE" (LEFT), "BAKER" (CENTER), AND ONE FINGER ON "ABLE" (RIGHT)

The Three Burned-Out Fuel Tanks Appear at Upper Left

Second only to its importance as a B-29 base was the use of Saipan as a supply and evacuation center. Simultaneously with the feverish work to put the airfields in operation, was the similar effort on hospitals; for not only were the wounded from the battle to be cared for, but immediately thereafter casualties were received from Tinian across the channel. Fixed hospitals having 6,000 beds were constructed, complete with water, sewer and electric systems, concrete sidewalks, and asphaltic paved roads. Another 3,000 beds were provided in temporary tent convalescent hospitals.

The supply function of the island called for extensive open storage, warehouse, and ammunition hardstand construction. The first warehouses were small frame structures, but as soon as the danger from enemy air action had been reduced, larger ones were built of wood frame, 100 by 304 ft in plan, with a 16-ft plate height, and designed to withstand a 60-mile an hr wind. Fifty-seven of these have been built.

The ammunition storage program called for the building of hardstands and access roads. In all, 475 hardstands (50 by 70 ft), 230 igloos (20 by 50 ft), and 65 miles of road were constructed. In addition there were a number of industrial and utility installations, including a "15,000-man" laundry, a Coca Cola plant, reconstruction of a captured oxygen plant, three garbage-disposal plants, an OWI propaganda radio station, a local broadcast station, an ice-cream factory, and a doughnut factory.

The key to the success of this construction operation was "teamwork" by all services and branches. The job was entirely too big for any one man or any one unit. The planning, design work, and supervision were done mainly by graduate engineers from all parts of the nation wearing Army Engineer castles or Seabee dividers. The men who swung the picks and drove the bulldozers night and day for many months had as their nucleus a core of experienced construction men from the building trades of the nation. Around this core were men from all trades and walks of life, who, with typical American adaptability, performed like veterans at their assigned tasks.

Wellpoints Dewater Denison Dam Closure Area

Largest Rolled-Earth Structure to Date Constructed on the Red River, Between Oklahoma and Texas

By Thomas C. Gill
Chief Engineer, Moretrench Corporation, New York, N.Y.

TO "dry up" the closure area of Denison Dam so that excavation to a suitable foundation could be accomplished, over 1,200 wellpoints were driven and pumped continuously. Water was pumped out of the porous soil at the rate of about 18,000 gpm. In addition to his description of the wellpoint layout, Mr. Gill has included a pump chart, which lists information obtained on fourteen pumps used on the job.

DENISON Dam is the largest rolled-earth structure constructed to date. Its completion by the Corps of Engineers, U.S. Army, across the Red River between Texas and Oklahoma provides for flood control and for storage for the development of hydroelectric power. Its total reservoir capacity is nearly 6,000,000 acre-ft. The rolled-fill embankment is composed of three sections—impervious, random-fill, and previous zones. From the deepest point in the foundation to the crest is about 190 ft. The base width at the maximum (closure area) is over 1,600 ft, and the entire length of the embankment is about 17,500 ft. More than 18,000,000 cu yd of fill were required in the main embankment alone.

The project required dewatering of the main closure area, containing mostly a very pervious soil, as well as of a slump area within the closure area, composed for the most part of silty and clayey material. While some difficulty was anticipated in this operation, the problem did not assume major proportions because of the strategic location of wellpoints according to a comprehensive plan. The area to be dewatered lay in the river channel and was underlain with alluvial fill resting on a sand formation known locally as Trinity sand. This sand formation was at first considered a potential problem, but by extensive explorations, which also included a test pit, it was found to be practically impervious. To sink the test pit, a large-scale pumping operation was required to remove 48 ft of water in a very small working area. Because of the difficulties involved, considerable trouble was anticipated in the unwatering of the closure area.

Wellpoint Line "T", Temporary Line "B", and Discharge Line D-4 at Downstream Cofferdam (Slump Area at Left)

Dewatering and stabilization of this area can be considered as a twofold job, consisting of (1) lowering the water table in the river area, and (2) complete dewatering of the slump area to permit excavation of undesirable material in the dry.

Closure was effected by diverting the flow of the Red River through the outlet structure and control works, by the construction upstream of a temporary earth-fill cofferdam 1,700 ft long (Fig. 1). This protected to El. 535 ft and extended for approximately 250 ft upstream from the proposed limit of the cofferdam. The construction of the downstream cofferdam (to El. 530) 800 ft long, determined the limits of the river area to be dewatered. The distance between the cofferdams was approximately 1,600 ft. The remaining surface water was pumped down to approximately El. 510 by open pumping. Seepage under the upstream cofferdam was approximately 3,000 gpm.

The original plan for dewatering and stabilizing the closure area included three main lines of wellpoint equipment. The first was to be placed along the downstream toe of the upstream cofferdam and was to intercept the flow of the river beneath the cofferdam. This line had to be separated from the other lines since pumping would be required for a considerable length of time after the slump area was completed. The remaining two lines of equipment were planned for the slump area. Some additional equipment was figured for the toe-drain trench.

Table I. Pump Chart for Closure Area of Denison Dam—Maximum Flow

Pump No.	Discharge Head, Ft	Suction Head, Ft	Loss, Ft	Total Head, Ft	Type	Rpm	Impeller, In.	Volume, Gpm	Header Length, Ft	Seepage, Gpm per Ft	No. of Well-Points	Gpm per Point	Pump Efficiency	Discharge Line
Z-3	33	25	17.8	75.8	Gas	1,450	12	2,000	338	6.0−	60	31.7	84%	D-1
Z-4	33	25	10.4	68.4	Gas	1,400	12	1,800	318	5.7−	70	27.2	83%	D-1
Z-2	28	25	24.0	77.0	40-hp elec.	1,750	10	2,000	315	6.4−	67	29.9	78%	D-2
X-1	33	25	28.0	86.0	60-hp elec.	1,750	11	2,400	341	7.0+	90	26.7	78%	D-2
Z-1	58	25	3.4	86.4	40-hp elec.	1,750	10	1,400	389	3.6	76	18.4	70%	D-3
Y-7	70	25	3.2	98.2	Gas Jetwell	1,200	17½	600	160	3.8−	44	13.6	75%	D-3
X-5	21	25	13.8	59.8	40-hp elec.	1,750	10	1,800	276	6.5+	75	24.0	73%	D-4
Y-6	41	25	13.7	79.7	Gas trash	1,200	15	500	...	...	..	....	63%	D-4
X-4	21	25	11.9	57.9	Gas	1,250	12	1,800	295	6.1	82	22.0	83%	D-4
U-2	21	25	16.3	62.3	Gas	1,200	12	1,200	390	3.1−	80	15.0	80%	D-4
X-3	21	25	6.2	52.2	Gas	1,100	12	1,200	414	2.9	106	11.3	81%	D-5
U-1	21	25	14.6	60.6	Gas	1,200	12	1,500	325	4.6+	65	23.1	83%	D-5
T-1	17	25	2.0	44.0	Gas	1,000	12	1,500	500	3.0	147	10.2	81%	D-4
A-1	16	25	3.8	44.8	Gas	1,300	12	2,500	360	7.0−	89	28.0	70%	

Actual dewatering operations on the upstream cofferdam followed this layout closely. Installation of the wellpoint line along the downstream toe (called the Z-line, Fig. 1) proceeded without difficulty until the work progressed into the river channel. Gravel and limestone fragments were then encountered at a depth of 7 to 10 ft, with some driftwood also, which made the jetting difficult. The points were then shortened from a 25-ft to a 20-ft length.

The dewatering effect of the wellpoint pumping was noticeable immediately after the pumps were put in operation, as the surface water and leakage from the cofferdam began to disappear from the nearby area. The two gasoline pumps (Z-3 and Z-4) on the north end of the Z-line pumped into a 14-in. discharge line (D-1) which was discharging three-fourths full, or about 4,200 gpm at the start. The two pumps (Z-1 and Z-2) on the south end of the Z-line were 40-hp electrics and discharged into the second discharge line (D-2). Pump Z-1 was later changed over to discharge line D-3 when pumping started on the slump area.

Discharge line D-2 was a 16-in. line which lay on a shelf in the bank on the south side of the slump area and discharged into the spillway. The highest elevation of this line was El. 540. The Guy F. Atkinson Company, contractors on the job, considered that the cost of installing this line would be much more than offset by the saving in head (a total of 30 ft) as against discharging over the upstream cofferdam, or the risk that would be involved if the discharge were built into the cofferdam below the crest elevation. Installation of the wellpoint equipment along the toe of the upstream cofferdam took about a week. The main items were 1,460 ft of 8-in. header pipe, 290 wellpoints, and 4 wellpoint pumps. This line did its job without the necessity of installing points across the north end, from the cofferdam to the steel sheet-piling cutoff driven underneath the finished structure.

EXCAVATION FOR TOE DRAIN—WITH WELLPOINTS INSTALLED AT EACH SIDE OF CUT

An interesting incident occurred when a rise in the Red River brought a water stage of 539 ft. This represented a rise of about 10 ft above the normal upper pool stage. The effect of this additional head on the water table along the upstream cofferdam was much less than had been anticipated. The average rise in the water level was only about one foot. In the remainder of the closure area no other effect was noticeable. The upstream cofferdam remained tight and no leaks were observed other than a little sweating.

The slump area was located adjacent to the outlet structure and control works on the south or Texas side of the cofferdam. It extended nearly the entire distance between the upstream and downstream cofferdams. Near the axis of the dam it was 350 ft wide. Logs of over 50 preliminary borings indicated a very large quantity of soft silty, clayey material containing limestone fragments. As it was the intent to remove this undesirable material, the dewatering problem required the installation of the wellpoint lines beyond the bounds of the silt formation.

The original dewatering plan of using upper and lower setups for the slump area was soon seen to be unsuitable for initial pumping operations. To start with, the preparation of the dam foundation disclosed that rolling the very fine red sand forming the river bed (averaging 50% passing a 200-mesh screen) caused considerable capillarity in this soil and required lowering of the water table to a greater depth before operations could be resumed. Therefore a temporary wellpoint line (A-line) was installed normal to the dam's axis and about equidistant east and west of the steel sheeting cutoff line, on each side of which the first fill of impervious material had to be placed. It was also located about 100 ft from the slump area so that the setup for dewatering this area could be installed at a lower elevation.

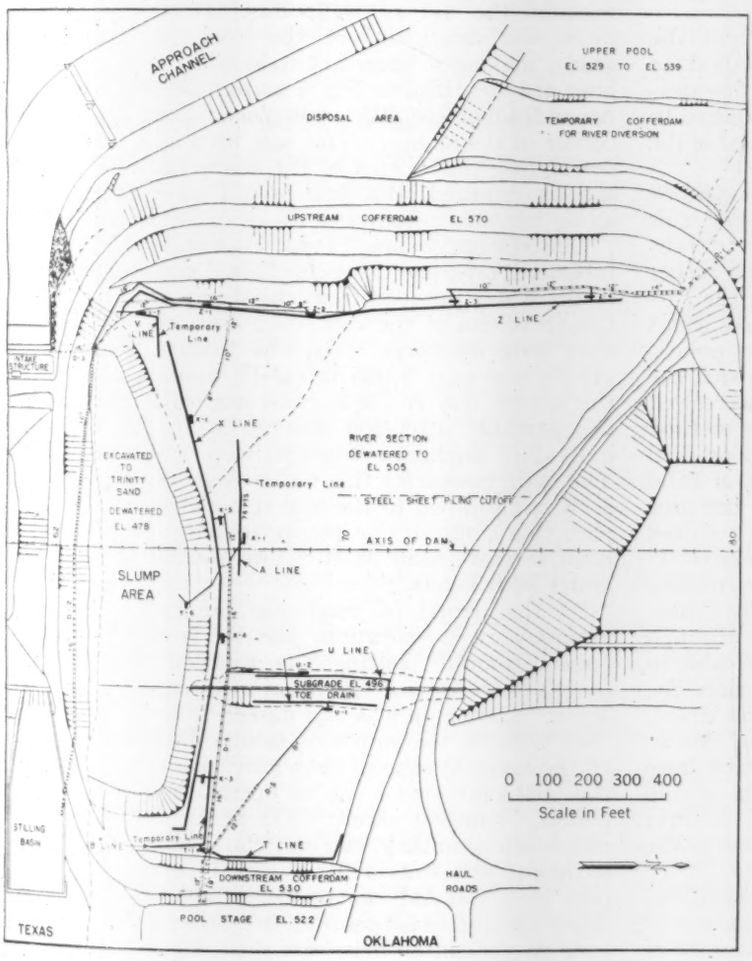
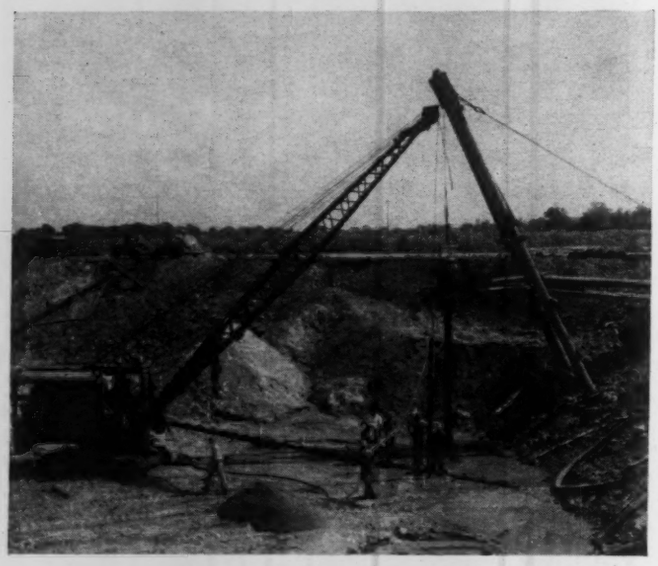


FIG. 1. CLOSURE AREA OF DENISON DAM

Pumping from the A-line produced very satisfactory results. It allowed foundation rolling to continue, access over a considerable area on a dry river bed, and partial excavation in the slump area. It was therefore decided to install another temporary line (B-line) at the southeast end of the closure area. This header line extended along the toe of the downstream cofferdam from



"HOLE-PUNCHER" OPENING A HOLE FOR A WELLPOINT THROUGH LAYERS OF CLAY

the extreme southeast corner, and westerly outside the slump area. This line determined the proper method for installing wellpoints on the main header line for dewatering the east end of the slump area, and was required to lower the water table sufficiently to allow excavation of the El. 505 berm along the limits of the slump area.

The first set of points installed on this L-shaped temporary line were jetted in. However, during this operation a layer of clay was encountered at depths varying from 12 to 16 ft, making the jetting rather difficult. When the line was put in operation, the surface remained spongy and moist, because of insufficient drainage through the clay and down to the points. Therefore a new series of points was installed with the Moretrench hole-puncher, and the wellpoints were well sanded with coarse sand and fine gravel. This method had not been previously employed on the job as field conditions did not require it. Varying grades of sand had previously made up the greater portion of the area penetrated and therefore a pervious backfill resulted from the jetting without the need of outside material.

Later an extension was connected to this line running along the toe of the downstream cofferdam, the T-line. The purpose of this line was to intercept the flow through the downstream cofferdam and lower the water table in the downstream end of the closure area so that the trenches for the 30-in. discharge lines from the toe drainage system could be excavated to grade in the closure area. Since the operation of the two temporary lines "A" and "B" permitted the first setup for the slump area to be installed at an elevation about 7 ft lower than was first planned, the need for a large portion of the second setup was eliminated.

The main header line (X-line) in the slump area was installed at El. 505 over the upstream end and sloped to El. 503 on the downstream end. The points were 25 ft in overall length and maintained the water level 21 ft below the header elevation. Four pumps were installed. (See pump chart, Table I, for detailed information.) Along the upstream portion of this setup little silt and clay were encountered, but on the downstream end it was necessary to use the hole-puncher to break up the bands of clay and gravel encountered.

Predraining of the slump area allowed it to be excavated in the dry close to the Trinity sand. Two draglines were used by the contractor for this excavation, which proceeded to a distance of from 2 to 6 ft from the Trinity sand without encountering free flowing water. Mud and water pockets were found but caused no excavating problem. The deepest excavation varied from about El. 582 to El. 579. To remove water from this lowest level, the trash pump (Y-6) was used, pumping from sump holes.

Backfilling and rolling of the sand fill for the slump area started with the upstream section and progressed downstream as fast as the excavating operation permitted. Fill was carried to El. 505 and then the two electric pumps, X-1 and X-5, were removed, together with the header line and wellpoints on the upstream side of the steel sheet-piling cutoff. The adjacent temporary line "A", which was still in place, was put back in operation by hooking up a pump. This permitted the sand fill to be carried high enough to be out of danger.

Three other wellpoint lines were placed in the closure area to dewater localized areas. It was necessary to place such lines along the east and west edges of the toe drainage ditch at the downstream toe of the main embankment so that the excavation of the ditch could be carried to grade. Cutting of the trench was started without the aid of wellpoints. However, the water table was struck before the work was completed to grade, making it necessary to install the points. These lines are identified in Fig. 1 as parallel single lines "U." An additional line, "V", was placed along the northwest corner of the slump. This was used as a further aid in dewatering that corner of the slump area and, had conditions required, this line would have been extended along the slump limits at an elevation lower than "X."

One discharge line (D-4), consisting of 18-in. steel pipe and tapering down to 12-in., conducted the bulk of the water pumped from the slump area. Because of the great size of the cofferdam area, there were several very long discharge lines, the longest being 1,860 ft (D-2), the next 1,065 ft (D-4), another 865 ft (D-1), the fourth 636 ft (D-3), and the fifth 450 ft (D-5). Considerable attention was given to the design, and individual discharge diagrams were made for each line. The main reason for this was to keep the friction loss on each pump down to the lowest possible amount. Even with this caution, one pump discharged against a total head of more than 98 ft. Two electric pumps worked under 86-ft heads.

At the period of maximum pumping, 11 wellpoint pumps were in operation, plus the trash pump and the Jetwell pump. During the interval in which these pumps were operating at or near capacity, a rate of about 18,000 gpm was maintained from the closure area. This included the pumps on header lines X, Z, U, and T. In the entire system of lines 1,258 points were used. All the wellpoints were not in operation during the same period; however about 1,050 were in operation at the maximum pumping stage. The average capacity per wellpoint was thus a little over 17 gpm. The highest pool stage behind the upstream cofferdam during the slump-area excavation was El. 539. Since the water level in the slump area was then El. 482 or lower, the greatest water-head condition was over 57 ft.

Hydraulics Courses Important in the Civil Engineering Curriculum

By HAROLD A. THOMAS, JR.

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TRADITIONALLY the teaching of hydraulics has been alined with the civil engineering curriculum. The practice of the profession of hydraulics has come to be more or less identified with the work of the civil engineer. Various forces have been in evidence during the past decade, however, that have tended to dissolve this long-standing connection. Nevertheless it is believed that the alinement of hydraulics with various phases of the civil engineering program is still logical and essential to the best interests of both sciences, and will continue to be valid in the predictable future.

A large part of the work in advanced civil engineering courses requires considerably more than a rudimentary knowledge of the behavior of fluids, particularly water. The advanced student in civil engineering must be conversant with the techniques of the hydraulic engineer in order to practice his own specialty. While it is true that other engineers, particularly mechanical and chemical, will continue, as in the past, to be concerned frequently with problems pertaining to the flow of water and other fluids, it would appear that the hydraulic problems handled by the civil engineer are so numerous, of such large scale, and of such great economic importance as to place the subject of hydraulics near the center of the foundation of training in the curriculum of the civil engineering student.

DEVELOPMENT OF SCIENCE OF HYDRAULICS

In order to define the position of hydraulics in relation to an overall program of engineering education, it is necessary to review briefly the development that has led to its rather unique situation in the profession at present. As is well known, the great technical accomplishments of the nineteenth century were generally accompanied, if not actively stimulated, by advances in theory in the various phases of engineering and technology concerned.

Hydraulics unfortunately was an outstanding exception. The approach to a lucid and definitive theoretical treatment of the motion of real fluids is obstructed by serious complications of a mathematical character. The engineer found that the highly theoretical development of classical hydrodynamics based on an ideal fluid gave him almost no assistance in the solution of practical problems; he soon became indulgently contemptuous of the efforts of the theoreticians. Since the theoretical results appeared to have a negligible value in the applied field, the hydraulician was forced to be content with the development of a "science of coefficients."

In the early years of the twentieth century, however, a new animation invigorated both the practical application and the scientific study of the mechanics of fluids. Growing activity in aeronautics and water-power engineering made essential a more satisfying mathematical approach than existed in hydraulics. Moreover, among the theoreticians there developed simultaneously a disposition to formulate natural phenomena more realistically, and to resolve discrepancies between theory and practice. With the long-delayed integration of pure and applied science, great achievements have been realized.

About 1930, the stimulus of the new research and mathematical synthesis began to be reflected in education. Hydraulic curricula and textbooks were refashioned; ideas and methods were lifted bodily from aeromechanics and other sciences and transplanted directly among the customary subjects of traditional hydraulics. While it cannot be maintained that the new material thus incorporated was invariably selected by teachers and textbook writers with the requisite understanding of the needs of the potential hydraulic engineer, there can be no doubt but that in engineering education a significant milestone was passed. Certainly the cross-fertilization achieved remarkable results in its time.

Today, however, the arrangement can no longer be considered satisfactory. The phenomena occupying the attention of the hydraulician differ markedly from those occurring in the field of aeronautics; as a rule, hydraulic problems are less amenable to mathematical treatment, and are beset with difficulties arising from anisotropic turbulence, boundary roughness, and surfaces of discontinuity.

The successful application in aeronautics of the theory of potential motion to flow around airfoils and other objects of regular outline can hardly be said to have important parallels in the field of hydraulics, where a simple geometric form is the exception rather than the rule. Useful as it has been in other fields, the direct application of the potential-motion theory to hydraulic structures is subject to serious restrictions, and the contributions of the theory to the practical design of structures have been relatively limited. Attention should also be directed to the relevant fact that hydraulics presents difficult problems of great economic importance, such as flood waves, cavitation, surges and transients in pipe lines, sediment transportation, or flow in compressible soils, for which there are no known useful counterparts in the domain of aeromechanics.

FLUID MECHANICS

In response to the influx of ideas and concepts from aeronautics and other active allied areas, the "fluid mechanics" course has been evolved. In many of our colleges of engineering it has almost completely replaced the older courses in hydraulics given to undergraduates. The incorporation into hydraulics of the new concepts borrowed from distinctly different fields has inevitably resulted in a fundamental deflection of objective. Today general principles of fluid behavior are taught without special emphasis on any particular branch of engineering. The subject matter treats alike of compressible and incompressible fluids; the Mach number receives equal billing with the Reynolds and Froude numbers.

There is no doubt but that emphasis on underlying general principles in fluid mechanics courses contributes directly to a better overall understanding, and constitutes an important forward step in education in so far as engineers as a whole are concerned. But by the same token it is inevitable that all the advantages cannot be realized without certain disadvantages. The pendulum-like swing in emphasis in subject material from the particular to the general has resulted in the rather startling phenomenon of engineering graduates who, despite a nodding acquaintance with fundamental principles and

sundry generalities, are incapable of solving elementary pipe-flow problems. The instruction time necessary to explain the theory of the wind tunnel has been taken from the time formerly spent on open channels and centrifugal pumps.

Consequently it would appear that the transition from the older courses in empirical hydraulics to the more recent courses giving a smattering of miscellaneous semi-advanced topics in fluid mechanics has not yet reached the desired goal, and that the treatment of the whole subject is very much in need of complete revamping. The initial infusion from aeronautics has about run its useful course; at present in many respects it constitutes more of a loss than a gain.

The important point involved is that as a result of the broadening of the base of instruction, additional particularized training is necessary in order that the student may undertake advanced work with the requisite degree of proficiency. This is especially true in civil engineering, where an understanding of hydraulics is a necessity, and the onus of closing the gap in training is placed squarely upon the teacher of graduate courses.

Few things may be taken for granted in the postwar era, particularly in education, but one eventuality is certain—there will be an increasing need for the extension of engineering education. The advancement of civil engineering as a science will continue at an accelerated rate as a result of wartime technological developments and, in equal measure, as a result of the inevitable resurgence of activity in the many promising fields of research that have been held in abeyance during the period of national emergency. Also, it is almost certain that the postwar years will see an extensive development of the water resources of the nation.

In the light of such projected activity, it is worth while to consider the close relationship existing between hydraulics and other divisions of civil engineering, of which hydraulics is the capstone. One fact is pertinent—the necessary basic instruction does not differ greatly as to type in many different phases of civil engineering. For example, a knowledge of hydrology, flow in pipes and open channels, and flow over spillway weirs, is essential alike in water supply, flood control, sewerage, water power, and irrigation.

It is evident that the science of hydraulics constitutes a fountain-head that nourishes a number of important phases of civil engineering. Logically, therefore, education in these phases should be formed around a framework of instruction in hydraulics. It is of interest to consider the content of hydraulics curricula at the undergraduate and graduate levels in order to determine what may be deemed adequate to meet the needs of the practicing engineer in the postwar period.

UNDERGRADUATE COURSES

For students in civil engineering, it is the opinion of the writer that the minimum undergraduate instruction in this field should consist of one basic course of at least one semester, carrying the title of "Hydraulics" or "Fluid Mechanics," and two courses of one semester each, carrying the title of "Hydraulic Engineering." The latter courses should cover the elements of hydrology and ordinary applications of the laws of hydraulics, mechanics, and economics to the design and operation of structures common to the fields of water supply, sewerage, water power, irrigation, drainage, flood control, and waterway improvement. These courses should include a brief survey of the broad principles pertaining to each of these fields. The first semester would cover the field as a whole so as to equip the student with the analytical methods and theoretical background necessary for the solution of problems in applied hydraulics. During the second semester the subject matter would deal more closely with design problems encountered in the planning and building of hydraulic structures. In the civil engineering undergraduate curriculum, the subjects of water purification, sewage disposal, and related topics can be treated to advantage in a separate course, presumably of one semester, carrying the title of "Sanitary Engineering."

At the graduate level, the content of the hydraulics and hydraulic engineering courses that should be taught to civil engineers consists of two parts, as follows: (1) a review and extension of elementary hydromechanics to make up for the deficiencies that result from omissions or incomplete treatment in undergraduate courses, since irregularities in training in fundamental science are inevitably found in a heterogeneous group of graduate students of varying educational background; (2) an introduction to the numerous new techniques developed during the past several years, which have witnessed a great deal of activity in hydraulic engineering in connection with government-sponsored flood control, irrigation, and water-power projects.

RELATED COURSES

In addition to advanced courses in hydraulic engineering, certain related subjects are essential parts of a balanced graduate program of instruction in hydraulics. Foremost among these are hydrology, hydrodynamics, and model analysis. A knowledge of hydrology, particularly of recent developments in the statistical approach to climatology, is a fundamental necessity in the practice of civil engineering. Part of a graduate course in hydrology should be a review of the salient developments in the lively science of meteorology, to include especially characteristics of air masses influencing precipitation.

A knowledge of modern hydrodynamics is essential for the graduate who intends to do work of a research character. A graduate course in hydrodynamics would ordinarily require an extension of the mathematical equipment of the student beyond the point normally attained in undergraduate work. In an advanced course in hydrodynamics it is desirable to include some consideration of compressible fluids; hence a certain amount of aerodynamics should be covered in order to present a unified and sufficiently generalized mathematical treatment of the behavior of fluids.

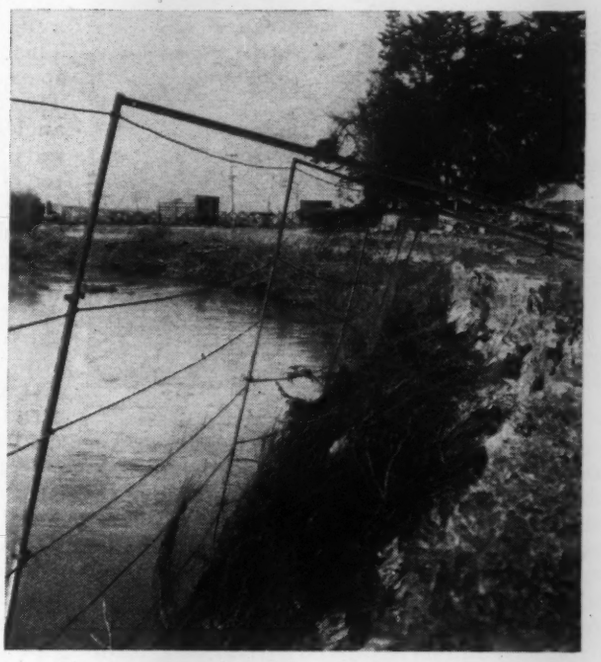
An important new tool of the hydraulician is the hydraulic model. Model analysis, employing the principle of dynamic similitude, provides an invaluable approach to many hydraulic problems. Indeed, the experience of the past decade has shown that the saw, the hammer, and the mason's trowel are just as important and legitimate instruments of the engineer as the slide-rule and the T-square. Accordingly, a graduate course on the theory of model testing and a review of results achieved in practice would comprise a useful addition to a program of advanced instruction in hydraulics. The work, of course, should be supplemented with laboratory exercises of a kind to bring out the underlying principles.

The foregoing considerations point to three conclusions: (1) instruction in hydraulics at both the undergraduate and the graduate level constitutes an integral part of the education of the civil engineer; (2) instruction of civil engineering students in hydraulics should be given in courses planned specifically for these students; and (3) rich opportunities for a career in hydraulic engineering in the postwar period are in prospect.

Steel Rails for Bank Protection on Salinas River, California

By H. F. Cozzens, Assoc. M. ASCE
County Surveyor and Road Commissioner, Monterey County, Calif.

FLASH floods and erodible banks present many problems in bank protection and flood control on the Salinas River, the third largest river lying within the boundaries of California. The river is 150 miles long and extends from the Bay of Monterey in a general southeasterly direction through Monterey and San Luis Obispo counties, draining an area of 4,200 square miles. It flows through the largest intermountain valley in the Coast Range. The land in the lower reaches of the valley is highly cultivated for vegetables and produces over 50% of the total commercial lettuce crop of the United States, as well as many other perishable vegetables.



Flexible Fence After One Winter Has Collected Considerable Protective Debris

In the upper portions of the basin, the general overlying formation consists of various kinds of sandstone and shale, the Monterey shale predominating. This shale has a very low specific gravity, and the residual detritus from its decomposition is a light sandy material that erodes easily. This accounts mainly for the peculiar ability of the Salinas River to carry large bed loads at relatively low velocities, and the difficulties that have been experienced in maintaining bridge structures and river banks. The slope of the river varies from about 1 ft per mile near its mouth to 14 ft or more near the headwaters. The average fall through the 90 miles of highly cultivated land is 6 ft per mile.

MEANDERING CHANNEL

Through this highly cultivated area the river channel varies in width from one-quarter to three-quarters of a mile. The high-water banks are not well defined and are very unstable during flood flows. As a result, the bank and channel lines shift constantly and there is much damage from erosion.

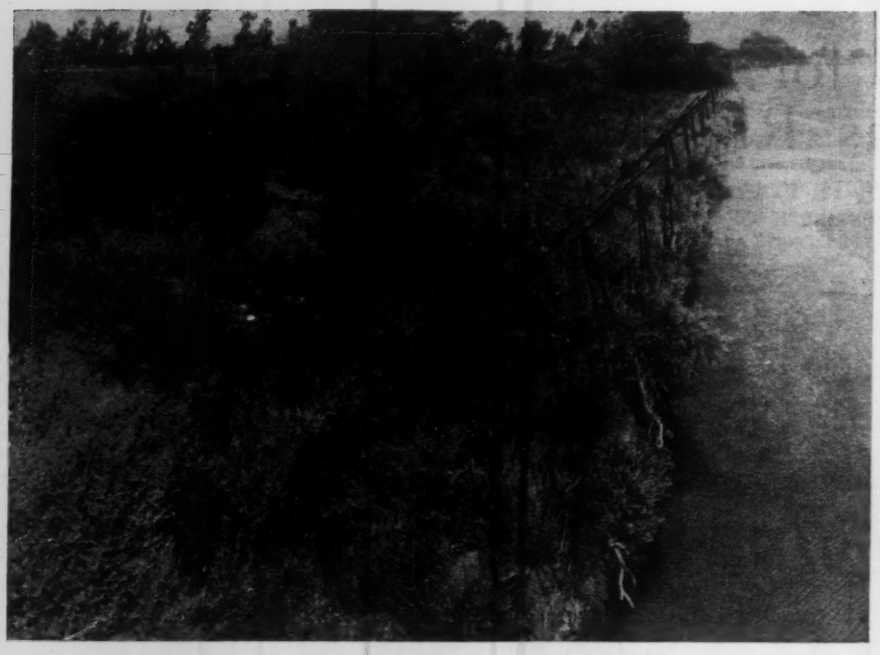
In the lower 90-mile length of the river there is an estimated area of 16,000 acres in the present river channel and in overflowed lands adjacent to it. Through this area the river meanders and changes its course with the various floods. The maximum recorded peak flow is 75,000 cu ft per sec, and a 2% chance flood is estimated at 85,000 cu ft per sec. Bank erosion occurs where the stream discharge reaches approximately 10,000 cu ft per sec. When it reaches 20,000 cu ft per sec, flooding of low farm land occurs.

In the 1938 flood, an example of an average large flood, the total estimated damage was $761,300, of which 48% was caused by inundation, 39% by bank erosion and damage to bank protection works, 8% by damage to roads and bridges, 4% by damage to railroad property, and 1% by damage to public utilities. The average annual flood damage in the basin is estimated at $164,000. During the past 50 years, private land owners, railroads, public utilities, and county and state highway departments have spent approximately $1,600,000 on bank protection work.

The first type of bank protection constructed on the river consisted of wooden-pile jetties from 60 to 180 ft long, driven at an angle of about 60° with the bank and spaced at intervals of from 200 to 300 ft. Between the jetties the bank was protected with willow mats and planted willows. This type of protection was used almost entirely up to 1925, when the iron "jack" was introduced into this section. This type has proved more economical and very efficient for low sandy banks.

"Jacks" are made from three 4 by 4-in. angles or from three 40-lb used railroad rails, 16 ft long, bolted together

Heavy Fill Deposited on Bank Side of Floating Channel Training Works



STEEL TETRAHEDRONS THREE YEARS AFTER INSTALLATION

at the center of each member to form the jack, and laced with heavy wire. The wire holds the units together and serves to slow the river currents and to catch floating debris. Jacks are placed along the river bank in one continuous row, or in rows of from 3 to 5 out in the bed of the river, and anchored with cables.

In order to obtain better protection at critical points, 30-ft steel tetrahedrons were introduced and have proved very practical and efficient. These are usually made from 30-ft, 45-lb used rails, six rails being bolted together at the ends to form the tetrahedron. Three 15-ft rails are fastened inside the tetrahedron connecting the center points of the 30-ft rails to stiffen them. The tetrahedrons are set on the bed of the river to the line of the proposed new bank, and rows of tetrahedrons extend inshore to the old bank at intervals of not more than 300 ft. The units are securely anchored with six longitudinal cables and with transverse cables placed according to the requirements of the particular installations.

FLOATING CHANNEL TRAINING WORKS SHORTLY AFTER INSTALLATION

A deciding factor in the design of protection works for this river is cost, which should be justified by the benefits realized. In 1941, after experimenting for many years, H. E. Rowe and Walter Gerow, civil engineers with the Spreckels Sugar Company at Spreckels, Calif., designed and installed a flexible fence for bank protection. This fence consists of 30-ft 50-lb rails, spaced at 50-ft intervals along the bank. Two 5-ft rail shoes are welded at right angles on the bottom of the upright rails, which are set about 4 ft from the toe of the slope in the river bed at an angle of about 10° off the vertical, leaning toward the bank.

From the top of these rails another rail is fastened with a hinge joint and is carried at right angles to the river to the top of the bank, where it is fastened with a hinge joint to an 8-ft rail driven 7 ft into the ground. Heavy cables are strung between the upright rails on 5-ft centers up to the 20-ft height, and an additional cable connects the tops of the rails. Wire mesh is fastened between the rails and wired to the cables. The height of the wire mesh is determined by the height of the bank and the estimated depth to which the fence will settle, but is ordinarily installed to a height of not less than 15 ft. Willow brush is placed between the fence and the raw bank. When the river rises, the fence settles into the river bed, forming a cutoff wall along the bank. In one case, in which the fence settled 15 ft below the bed of the stream, the upright rails were spliced out and extra cables and wire mesh were added to allow for further settlement.

Observations on the sections of this type of fence which have been installed show that it does not get out of line where it settles more in one section than in another, and that none of the rails has been broken, as is the case where rails have been driven vertically in place. It is assumed that the reason for this is that the fence is flexible and can give with the impact of floating logs and other debris instead of offering a rigid resistance. This type may be installed at a cost of from $1.50 to $2 per lin ft of bank, whereas the cost of the 30-ft tetrahedrons is from $5 to $6 per lin ft.

FINANCED BY LAND OWNERS

All the protection work that has been done on the river has been carried out by individual owners to protect valuable land, by the county and state to protect bridges and highways, and by the Southern Pacific Railroad Company to protect its line, which runs along the right bank of the river for about 7 miles. During heavy floods on many occasions the railroad has been forced to use emergency methods to save its main-line track. On two occasions it has dumped loaded gondola cars from the tracks into the river to save this line.

Until recently most of the works constructed by private and public bodies on the Salinas River were not correlated in any way. As there was no district organization, no arrangements were made to keep a uniform section of the channel cleared of vegetation and snags. In 1936, at the request of local interests, who realized that the various efforts should be consolidated, the Corps of Engineers made a survey and report for flood control

works on the river, and since then has made investigations and further reports on proposed means of controlling the stream. In order that local interests might carry on experiments to protect the banks, the Corps of Engineers, San Francisco District, designed a system of floating training works from observation of works previously installed on the river. It is proposed to use these to lead the main stream in a definite channel, which is to be kept clear of debris by annual clearing.

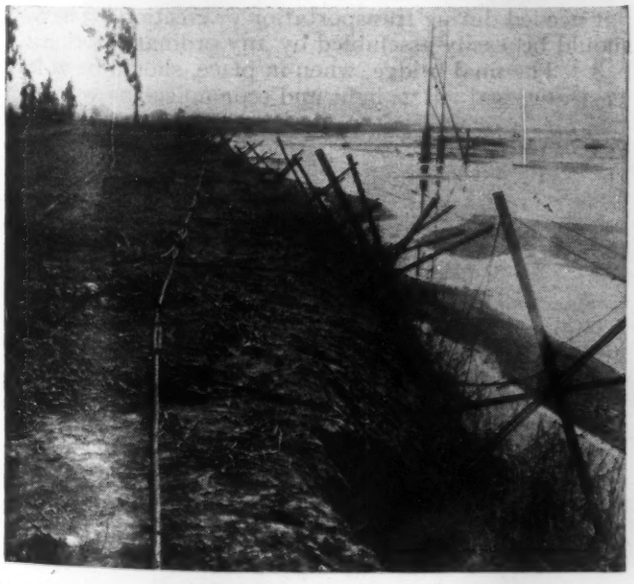
Two trial sections of floating training works have been installed by local interests at critical points, and are now under observation. This work consists of placing deadman anchors at the upper and lower extremities of each installation, running a main-line anchor cable along the proposed bank line, and fastening it to each anchor. The main-line cable is then anchored at intervals of about 1,000 ft on the convex side of bends by lateral cables fastened to 20-ton anchors on the shore, and on the concave side of bends by three-pile dolphins. Wooden jacks, constructed of three 8 by 8-in. timbers 16 ft long, bolted in the center and wired with No. 10 wire between timbers, are then fastened to the main cable by 30-ft cables at 30-ft intervals.

In order to set up proper sizes for cables and loading for anchors, the San Francisco District of the Corps of Engineers carried on extensive tests to determine the degree of loading the installation would be subjected to during actual flood conditions.

A YEAR'S GROWTH OF WILLOWS OFFERS AN EFFECTIVE BARRIER TO EROSION

REPORT FILED AND FAVORABLE NOTICE ISSUED

An interim report on the Salinas River was forwarded to the Division Engineer on August 29, 1944. Under date of September 27, 1945, he issued a favorable public notice on the project. This project provides that a permanent channel be established for the lower 93 miles of the river by the use of floating training works, flexible fence, and other types of bank protection as previously described. The proposed channel is to have a cross-section varying from a width of 540 ft and a depth of 14 ft to a width of 1,100 ft and a depth of 7 ft; it will provide for the control of floods not in excess of 50,000 cu ft per sec, which correspond to the 15% chance flood.



INSTALLATION OF STEEL JACKS ON THE SALINAS RIVER BANK

It is proposed that the channel be cleared of all growth when constructed, and maintained in that condition annually. Willows and other growth, when removed from the channel, will be deposited on the bank side of the channel training works. The proposed channel works are to be constructed on those sections of the river where excessive bank erosion has occurred, causing large wash areas, bays and oxbows in the channel. The proposed works will reduce the velocity of the water where it encounters the line of jacks and cause the deposition of its silt load and detritus. Also, the increased velocity between the lines of the training works will tend to establish the desired channel.

IMPROVEMENTS TO COVER FIVE-YEAR PERIOD

During periods of heavy flow the bays between the original river bank and the line of parallel training works will become filled with flood-carried sediments, which will support a growth of willows and other vegetation the following season. These volunteer growths, plus proposed plantings, will eventually stabilize the new bank line and hasten the rate of silt deposition in the bays. Eventually this growth, plus the training works, flexible fence, jacks and tetrahedrons, will provide a stable channel adequate to carry a flood of 50,000 cu ft per sec without damage to the lands adjoining the river.

It is the opinion of local interests that the types of protection works which have been described will successfully control the river for all floods not in excess of 50,000 cu ft per sec. They have requested that further plans be made to control all flood flows in excess of that amount by the construction on the headwaters of flood control reservoirs, which could be partially used for water conservation, which also is now badly needed in this rich valley.

The proposed improvements would be carried out over a period of not less than five years in order that the channel might be established in stage construction by taking full advantage of willow and other growth to assist in stabilizing the banks back of protection works.

The Callender-Hamilton Bridging System

By A. M. Hamilton

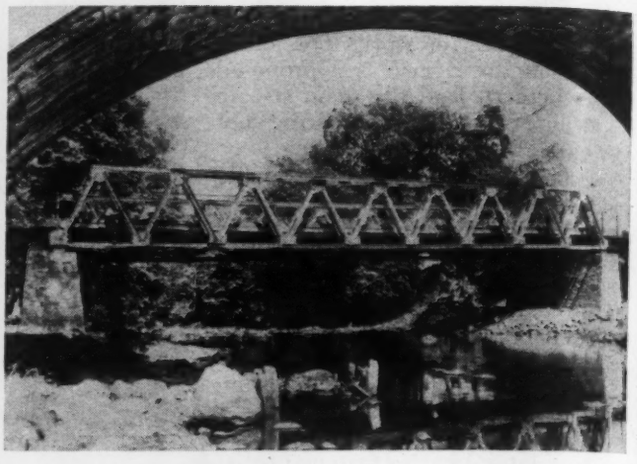
THE idea of the Callender-Hamilton bridging system arose in the following way. Construction of the Rowanduz Road in Iran in 1928–1932 involved some unusually difficult bridging over canyons and rivers in very inaccessible country in the Zagros Mountains, which here fringe northern Iraq.

Owing to the scarcity of timber, steel bridging gave the only possible answer to the problems involved, and it so happened that various types of bridges had to be employed. In Iraq there were stocks of nearly all the types of steel military bridges used in the first World War, and these and some others specially designed for certain crossings were sent up to the road head. The specially designed bridges had been manufactured in England. After completion they had to be transported by sea and then 600 miles overland, partly by rail and partly by road from the nearest port, which was Basrah, so the delay in obtaining them was naturally very considerable. Moreover the difficulty of knowing the correct spans to order, with but little knowledge of the flood levels of the rivers, added still another factor to the problem of supply.

In these circumstances there was an excellent opportunity to study the whole problem facing the colonial bridge engineer. If this problem could be solved in some realistic and entirely new way, the same means should be of help to bridge engineers generally. So having transported, assembled, and erected a considerable number of these older types of bridges, with no help other than unskilled tribal labor, and while still completing the rather formidable road excavation, the writer in 1930 in collaboration with G. D. White-Parsons sketched out a new type of bridge that would best meet the requirements of speed and simplicity.

The plan was to provide ready-made bridge stocks which would be so adaptable to any bridging problem that the crossing of a stream, river, or other obstacle anywhere would be capable of immediate accomplishment in a quick, yet permanent and economical manner. The same set of bridge parts, for example, would be capable of serving equally well for a pack bridge in the Assam jungle or for carrying buses on a London street—services which in fact they perform today.

The structural principles underlying all types of steel bridge trusses and girders have long been well understood. This makes it difficult to introduce any real novelty into bridge design. It may generally be said that apart from using more expensive steels or new light alloys, weights and costs of similar well-designed bridges should be of a like order, and the minimum overall cost is usually obtained from the simplest construction. So specifications for the new bridging materials were drawn up by the writer somewhat as follows:

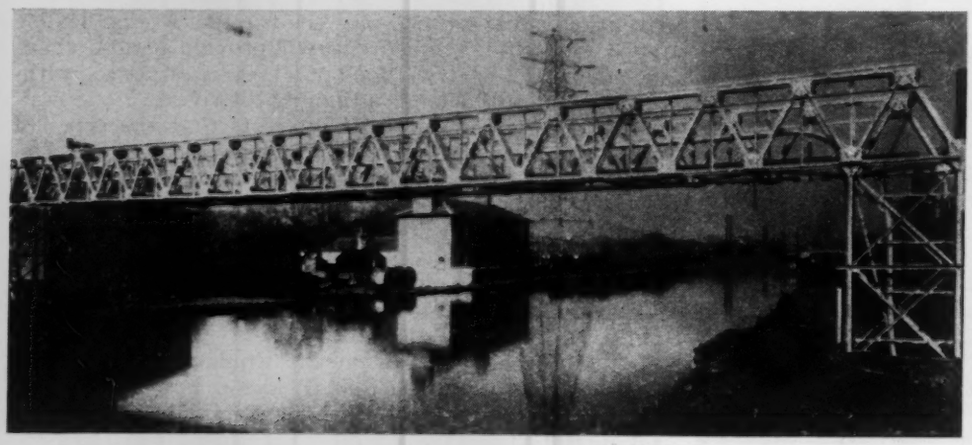


This Callender-Hamilton Bridge, in Northern England, Carries a 20-Ft Roadway Over a 90-Ft Span

1. The steel sections should be those obtainable from any steel mill. Fabrication of the steel into bridge parts should be possible in any ordinary workshop. If high-tensile or special weld-quality steels are available so much the better, but they are not vital. Thus manufacture can be conducted almost anywhere, and local industry can benefit.

2. The parts of the bridges should be as light as possible to be easily handled by one or two men (in railway bridges the parts are naturally somewhat heavier). Thus large gangs, except perhaps for greater speed, are not needed during transportation or erection. The parts should be easily assembled by any ordinary workman.

3. The final bridge, when in place, should be at least as strong, and yet as light and economical, as a specially designed bridge, whatever the span. This was the really difficult condition to fulfill. Under the new system, however, a patented feature was introduced whereby the strength of the bridge members is readily proportioned to the load they have to carry. This innovation for standardized bridges enables not only a bridge of one degree of strength to be provided for a given span length, but a reasonably economical bridge to any loading specification, whether light or heavy. Further, by stepping up the depth of spans as the length of bridge increases, a



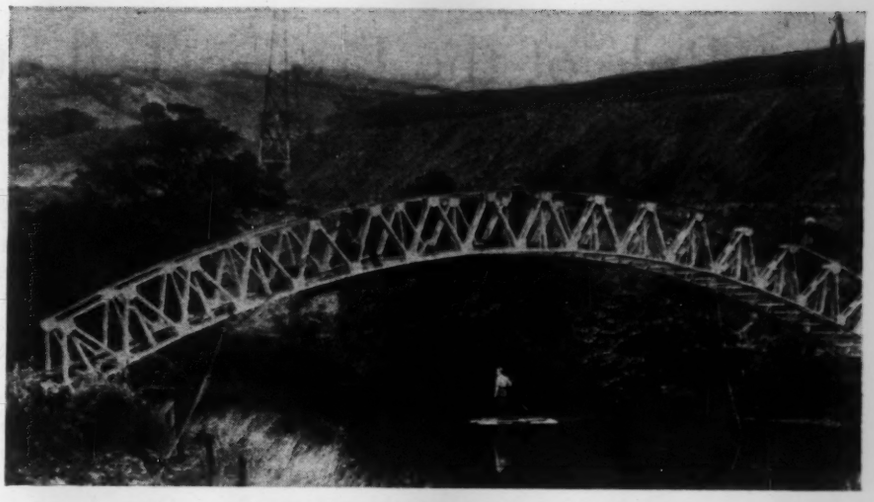
For a Long Span Over a Canal, This Bridge Was Fabricated from Standard Units

very much wider range of bridge lengths is secured than anything previously contemplated.

4. The individual bridges should be capable of fast assembly and erection. For especially rapid erection, such as military conditions might impose, standardized panels are not excluded and may be pre-assembled. Still other variations can be readily employed where speed is an overriding consideration.

5. The parts should be adapted for forming into through or deck-type bridges, also serve as steel piers, columns and bridge substructures—uses they fulfill today.

6. As a test of the overall economy, the total number of man-hours required for fabrication and erection and maintenance should be equal to, or less than, that of any other type. This is regarded as an important criterion. It is interesting that, after the design was made, Callender's Cable and Construction Company found the unit parts to be very suitable for galvanizing in accordance with transmission-tower practice, and as the bridges are therefore generally supplied fully galvanized, even to bolts and end bearings, they need little or no further attention, whether in storage or in actual service. Thus painting may be dispensed with and much labor of maintenance is saved.

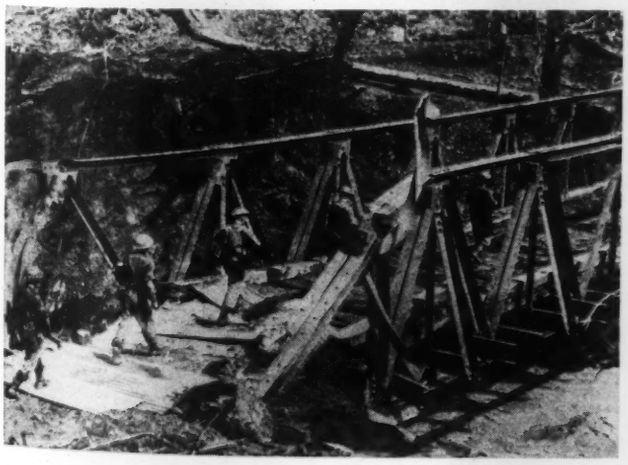


READILY ADAPTABLE TO VARYING CONDITIONS, THE BRIDGE UNITS HERE FORM A CABLE-CARRYING ARCH

DESIGN ASPECTS

Close attention has been paid to the structural design. Both by calculation and actual tests of the unit parts and the made-up bridges, the strengths of all spans and their factors of safety are accurately known. Moreover the values of the individual members according to the various standard bridge-stress specifications are known and listed, so that designs for new conditions are very quickly arrived at.

To obtain the most economical bridges on exactly the same general system suitable for such light duty as footbridges and such heavy duty as railway bridges, the principle of "similarity of structures" has been used, whereby proportions of all truss members are largely kept the same but the scale size is changed as a whole. Thus the steel weight in a small footbridge might be only half a ton and that in a railway bridge 300 tons, but each would be of the same order of high efficiency for its duty.



A CALLENDER-HAMILTON BRIDGE IN ASSAM CARRIED FOOT TRAFFIC EVEN AFTER ATTEMPTS BY RETREATING JAPANESE TO DESTROY THE SPAN

During its first ten years of effective life, this bridging system has already fulfilled a wide range of uses, both civil and military, in Great Britain and throughout the world, while the number of different users who have adopted the system has steadily increased. Typical instances of service in the British Isles include cable bridges, factory bridges of many different sorts, footbridges over main traffic arteries, and highway bridges placed where there has been bomb damage to viaducts, or where older bridges have been unable to carry modern traffic. In what might have been one of the most serious episodes of the air "blitz," these standardized trusses replaced at short notice a bridge carrying a vital 8-ft-diameter sewage main in a densely inhabited quarter.

In cities and on main road arteries of the country they have been carrying for some years a significant part of Britain's heaviest war traffic. Even 150-ton vehicles have gone safely over them. In army use they take the heaviest tanks with ease.

WIDELY USED AT HOME AND ABROAD

In particular, the bridging system has been the standard one held in reserve to replace, as needed, all the major bridges of the United Kingdom, should any of them be destroyed or seriously damaged by the enemy. Single- and double-track spans up to 200 ft have been ready in every detail throughout the war, and all the leading bridge contracting firms have staffs trained to use them.

The ease with which the bridges can be fabricated has made them suitable for production throughout the Commonwealth, and large numbers have been made and put in use. Overseas armies have used them in nearly all the war theaters since the earliest campaigns, and their toughness after attempted enemy demolition is well illustrated by the accompanying illustration of a bridge on the Burma frontier, still standing after severe damage.

The system has already justified all the hopes the writer had for it after so short a period. Yet its full impact as a world-wide bridging service is likely to come, not during war when so much bridge work is strictly controlled and the steel supply is so limited, but rather in the days of peace and reconstruction when the economics of bridge-building again receive full attention and great new schemes for land communications are put in hand.

Role of the Lower Tributaries in the Missouri Valley Plan

By H. W. Wood, Jr., M. ASCE
Professor of Civil Engineering, University of Missouri, Columbia, Mo.

SPRING floods on the Missouri River in 1943 focused widespread attention on the general problem of water conservation in the Missouri Valley. The immediate outcome was the well-known Pick Plan (see "Flood Control Plans for the Missouri River," R. C. Crawford, CIVIL ENGINEERING, October 1944). At the same time the Bureau of Reclamation Plan was taking form (see "Regional Development of the Missouri Basin," Harry Bashore, CIVIL ENGINEERING, November 1944). The plans were both comprehensive and would accomplish much the same purpose, the Army emphasizing flood control on the Missouri and Mississippi rivers and navigation on the lower Missouri, while the Reclamation Service stressed irrigation and development in the upper basin. The two proposals were reconciled at a conference held in Omaha in October 1944. The resulting compromise Missouri Valley Plan embodies the best features of both plans (*Engineering News-Record*, December 14, 1944).

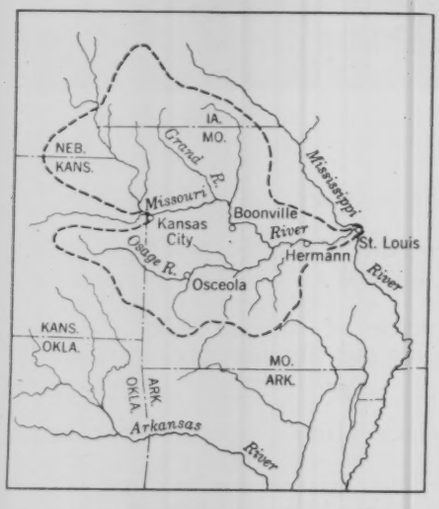


FIG. 1. LOWER MISSOURI RIVER BASIN

At present, with funds already allotted to the principal agencies for drawing up detailed plans, it is time to examine carefully the situation in tributary areas. In some instances reservoir sites have been selected with the principal purpose of regulating flow in the main stem and reducing flood crests on the Mississippi River. Almost complete flood protection for the tributary valleys below the reservoirs will be accomplished, but the large reservoirs are placed well downstream and no relief is thereby obtained for the upper reaches of these valleys. Much good farm land is taken permanently for the reservoirs themselves and this must be offset by protection of other lands. This protection is accomplished by creating new storage to offset the natural valley storage resulting from overflow of lands downstream.

Some idea of the flood potential of the lower Missouri tributaries can be gained by a study of the performance of the Osage River during the floods of May and June 1943. The coincidence of heavy storms over the Osage and adjoining watersheds with high stages on the Missouri main stem, due to melting snows in the headwaters, sent the lower Missouri out of its banks to the highest stage since the historic flood of 1844.

The Missouri River basin is shaped like a great funnel converging toward the southeast (Fig. 1). Beginning at a point in central Missouri, the flood plain narrows down from a width of eight or ten miles to an average width of two miles. This reduces natural valley storage to a degree where local floods on the lower tributaries can produce serious rises in the main stem.

The Osage basin, covering an area of 15,300 sq miles, had been subjected to heavy general storms during April and early May of 1943. On May 17, following several days of moderate rainfall, there began a three-day downpour which covered the entire lower Missouri basin and which produced more than 80% runoff on the Osage watershed. At Hermann, below the mouth of the Osage River, the Missouri River crest rose to a height of 31.2 ft, 10 ft above flood stage, or the gage height at which overbank flow begins. The Osage high water of May 20 to 24 coincided with a rise above flood stage in the adjacent main stem. This latter was caused principally by snow melt in the headwaters accompanied by flood water from the neighboring tributaries. Had the storage reservoirs authorized for the Osage and Grand rivers been in operation, this flood on the main stem could have been held within the banks, but the tributary valleys upstream from the reservoirs, and those wholly without reservoirs, would still have been unprotected. The effect of timing is seen in the rise of late June 1943 (Fig. 2). The main stem stood 10 ft above flood stage without having received any appreciable contribution from the tributaries of the lower valley. If this condition had coincided with the May rise in the tributaries, the main-stem stage would have approached the disastrous stage reached in 1844. It takes no great imagination to see how regulation of a large number of tributaries can throw the contributing flood crests out of phase.

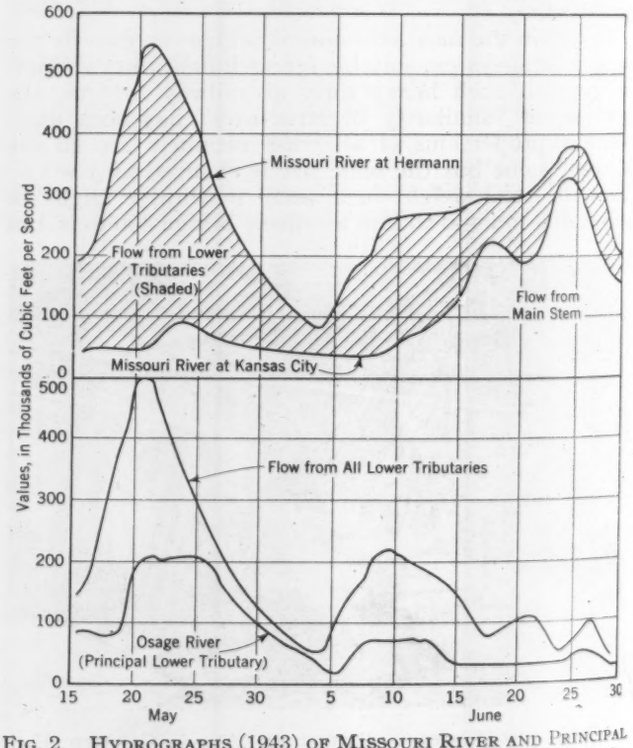


FIG. 2. HYDROGRAPHS (1943) OF MISSOURI RIVER AND PRINCIPAL TRIBUTARIES—ADJUSTED FOR TIME OF FLOW TO HERMANN, MO.

A statistical study of the Osage flood records is significant in view of the length of the record period. Stage records for this stream extend back almost continuously to 1881. Through the efforts of the hydraulic engineers of the Union Electric Company, which operates the generating station near Bagnell, and the U.S. Geological Survey, the stage records have been converted to discharge rates and the effect of the reservoir has been determined. The converted records form a statistical series of more than sixty natural annual floods.

In applying the Hazen method of plotting the data, the average smooth curve was found by using a graphical coefficient of skew. The series was terminated with

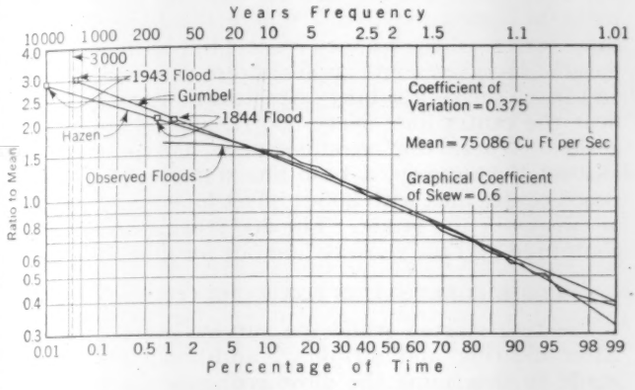

Years Frequency
10000 1000 200 50 20 10 5 2.5 2 1.5 1.1 1.01
3000
1943 Flood
Gumbel
1844 Flood
Hazen
Observed Floods
Coefficient of Variation = 0.375
Mean = 75086 Cu Ft per Sec
Graphical Coefficient of Skew = 0.6
Ratio to Mean
4.0 3.0 2.5 2.0 1.5 1.0 0.8 0.6 0.5 0.4 0.3
0.01 0.1 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99
Percentage of Time

FIG. 3. FLOOD PROBABILITY CURVE FOR OSAGE RIVER, 1881–1942

1942 because the 1943 flood produced an abnormal amount of skew. This flood on the Osage was 40% greater than the 1844 flood and indicates a probable return period of 5,000 to 10,000 years when extrapolated on the probability graph in Fig. 3. The 1844 flood represents a frequency of the order of 150 years. A shorter probability series beginning with 1921, when the general stream-measuring program began, indicates a frequency of 3,000 years for the 1943 flood.

As a check, a procedure proposed by Prof. E. J. Gumbel (*Engineering News-Record*, June 14, 1945) was used. The Gumbel method employs the same process of sampling but uses a purely mathematical system for computing return periods. The plotting scale produces a straight-line graph, but in Fig. 3 the resulting frequencies have been transferred to the Hazen chart. By this method the return period of the 1943 flood appears to be about 3,000 years, verifying the Hazen result.

This extremely rare probable frequency would, in itself, normally allay any apprehension of a recurrence of a flood of such magnitude; but a study of the rainfall possibilities of the region leaves considerable doubt as to the wisdom of relying on probability frequencies. A glance at the isohyetal maps of the late May 1943 storms (Fig. 4) shows that the lower Missouri River tributaries lay on the outskirts of this great storm, which centered beyond the divide and in the Arkansas River watershed. Now, suppose that this storm had been centered 150 miles farther northeast, as indicated in Fig. 4 (*b*). This transposition would be quite possible from a meteorologic standpoint. It suggests the great flood potential, not only of the Osage basin, but of all the lower minor tributaries of the Missouri River. The liability of the lower Missouri Basin to heavy storms is further indicated by the computations of the Miami Conservancy District and presented in its Technical Reports (Part V, "Storm Rainfall of Eastern United States," 1936).

While the Missouri Valley Plan lays no great emphasis on soil conservation other than irrigation, the Soil Conservation Service is formulating plans for large-scale operations calculated to check the rapid erosion of the top soil and build up ground-water supplies. An extensive experiment is being planned which will test the effectiveness of a large number of coordinated small headwater reservoirs in abating floods, building up ground water, and checking silt pollution. The Meramec River, a tributary of the Mississippi which enters it near St. Louis, draining an area of nearly 4,000 sq miles, has been selected for this project and plans are well advanced. Preliminary studies show that unregulated retention reservoirs on the lower tributaries may actually increase flood stages by retarding the runoff until it coincides with the peak flow from upstream. Much valuable information should be obtained from this experiment.

It is not normally considered feasible to try to regulate completely floods of extremely rare frequency for the protection of farm lands and sparsely settled areas; but the storage capacity allotted to flood control in the three approved reservoirs on the Osage system is more than enough to hold the entire flow of the May 1943 flood, while many points upstream are left without reservoir protection. On the Grand River a similar situation exists. Here some improvement in the plans has been made by abandoning the original single reservoir site and dividing the storage between two smaller reservoirs, one farther upstream on the Grand River and the other on a tributary, the Thompson River. This problem of dispersal of flood-water storage for the protection of upstream areas should receive careful consideration. The main reservoirs, on the other hand, must have sufficient capacity for effective operation; and, on streams suited to power generation, large-size reservoirs are necessary to provide the needed head.

The exact place and importance in the overall water plan of the development of small tributary reservoirs, farm ponds, terracing, strip cropping, contour plowing, gully checking, and various other soil conservation de-

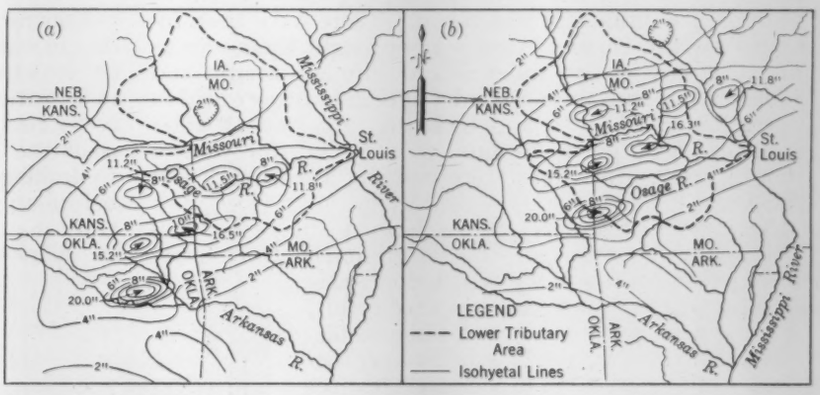


FIG. 4. ISOHYETAL MAPS OF (*a*) STORM OF MAY 13–20, 1943, AND (*b*) SAME STORM TRANSPOSED 150 MILES NORTHEAST

vices are not yet clearly evident. Neither the grand-scale system of great reservoirs and levees on the one hand, nor a highly developed system of land management as envisaged by the soil conservationists on the other, will alone accomplish all that is needed to control the waters of the Missouri Valley. The successful Missouri Valley Plan must provide a basic system of stream control upon which soil conservationists may build to accomplish the ultimate objective of security for every community against flood, drought, and erosion.

Round-the-Clock Job for the Task Force

Flexible-Base Runways Installed for Airdromes on Pacific Isles

By W. G. STAGGS, MAJOR, C.E., ARMY OF THE U.S., *and* J. H. DUDLEY, COLONEL, C.E., U.S. ARMY
RESPECTIVELY EXECUTIVE OFFICER AND COMMANDING OFFICER, 931ST ENGINEER CONSTRUCTION GROUP (AVIATION)

MAKING TEST HOLE FOR SOIL PROFILE AT SITE OF AN ISLAND AIRDROME

NO ONE in his right mind would contemplate building anything larger than a bamboo shanty in the terrain encountered on most South Pacific isles. Yet in such impossible spots airfields were built in not months but days! Twenty-four hours a day, through blistering heat and deluges of rain, the engineers pushed the topography around until the B-24's had a spot where they could land, refuel, and take off, spearheading the attack.

Airfield construction units generally landed on D-Day and went in with the infantry, starting construction as soon as a suitable site was taken. There have been instances where engineer troops have fought their way as much as twenty-five miles inland through swamp and jungle and mountains and had a fighter-transport field in operation on D + 8, and thereafter received all their supplies, fuel, parts, rations, etc., by air for over a month, while other units were building a road and port facilities.

Tentative sites were chosen from a study of aerial photographs, but the entire lack of ground control in most instances made the intelligent topographic interpretation of such photographs difficult, and the determination of grades impossible. Even the layman, reading newspaper accounts of operations in this theater, realizes that there are no accurate maps of islands in this unexplored corner of the world. The coasts are not even charted accurately, and little is known of the interiors.

SITE, SELECTION, AND DESIGN SURVEYS

On a new operation the Engineer Unit Commander, with his senior staff officers and survey parties, arrived at the site on the heels of the leading infantry. A quick inspection was made of the sites previously selected from the photographs. Then surveys were made on the best site to fix the exact location. This had to be done very quickly as construction usually started only a few hours after the Engineer Commander arrived. Survey lines were frequently cleared with a D-8 'dozer, anything smaller being of little value in clearing jungle with the speed required. Where the hasty reconnaissance had fixed the runway control line within a few feet, parallel base lines and profiles were run simultaneously 150 ft off the center line. An elevation was then taken near the center line, every 500 ft, and at breaks in the grade. Where the reconnaissance had only generally located the runway, a base line was run near the proposed center line, with 300-ft offset lines every 500 ft and at breaks in the grade. The 600-ft-wide area was then contoured and the runway laid out for minimum work.

CLOSE CORRELATION FOR RAPID CONSTRUCTION

Clearing started while the surveys were in progress. After clearing and stripping, additional surveys were made to determine the most economical profile within the limits of the design criteria. Then the survey parties placed grade stakes and marked the cuts, fills, and slopes. As construction started on the arrival of the first piece of equipment and was pushed to the maximum, the survey parties had to step fast to keep ahead.

When the survey parties started work, the Soils Section was right behind. This Section dug test pits along the runway in at least two, and preferably three lines, to determine the soil profile and the nature of the various soil strata. In many cases it was found desirable to strip down to a coral base. The Soils Section also inspected suggested borrow pits.

DRAINAGE DESIGN

Contrary to good civil practice, a complete drainage design was often not prepared during the initial stages of construction, because of the urgency of getting a field in operation. The runways and dispersal areas frequently cover two thousand acres, all in dense jungle which conceals the minor variations in topography so important to drainage. The runway would usually be in use almost before the survey parties could cover the entire area. Only the major drainage could be determined in time to be included in the runway construction. Details were

DRAINAGE CULVERTS WERE FABRICATED NEAR THE SITE FROM USED OIL DRUMS

worked out concurrently with the construction. The lack of any records on rainfall made any rational planning of drainage capacity difficult. Usually a few years' record of some place within a few hundred miles was used and adjusted by an estimate of the effect of terrain.

Lack of time, equipment, and materials precluded the use of anything except flexible-base construction in this area. The materials encountered and used for such a base included coral, limestone of varying degrees of hardness, and siliceous river gravels in limited quantities, but rarely in sufficient quantities for this use. An excellent quality of fractured limestone was found in one location and was used with good results as a base material.

LIMESTONE FOR AN EXCELLENT BASE COURSE WAS FOUND IN A SIDE-HILL QUARRY

SOME PRACTICAL CONSIDERATIONS

At another location a soil mixture of hematite and micaceous sand was used as the base material for a runway, with poor results. Soil stabilization is rather impractical for use in theater-of-operations construction. It requires too much time and equipment and a degree of expert supervision and laboratory control not generally available. It should only be used as a last resort. Flexible bases were designed for local materials, to theater-of-operations standards. The California Bearing Ratio was used to determine base thicknesses.

Because of the short operational life of airdromes in this area, no very durable surfaces were required. Surface treatments were designed to meet operational requirements. In some instances a tar dust-palliative was used for light traffic. Some airdromes required a tar prime coat and a single asphalt surface course of 0.3 gal of asphalt per sq yd, blotted with crushed-stone chips or coarse sand. Steel landing mat was used wherever operations required an all-weather surface in the shortest possible time.

CONSTRUCTION METHODS

Methods of construction employed in this theater differed little from the old familiar pattern, except that the volume required and the limited engineer effort available probably made it necessary to cut more corners and make maximum use of all equipment. Grading was in accordance with common practice as regards selection of materials and proper compaction at optimum moisture, except that stripping operations were very extensive, it being necessary to remove the topsoil entirely, often 2 ft in depth.

After stripping, it was common practice to sink the finished grade line into the coral subsoil, thus requiring little base material to be excavated by shovel and hauled by truck. Shovels of sufficient size to furnish material to pave an area the size of a heavy bomber runway in a week's time are not easily adapted to the mobility required in this area of jungles and swamps, no roads, and poor port facilities. For these reasons most base courses were built by the use of tractors, 'dozers and carryalls, and finished with motor graders, water trucks, sheepsfoot rollers, pneumatic-tired rollers, and flat-wheel rollers.

With coral, a dense hard surface can be secured by repeated scraping, sprinkling, and rolling. Frequently three or four repetitions are required. Each time the motor graders take smaller cuts, and end up by barely nicking the surface. The result is as smooth as concrete and almost as hard.

Where asphalt or tar was used, the bitumen was applied with a standard pressure distributor. The materials arrived in drums—usually after so many handlings that all marks were obliterated. A few samples would be tested, then the treatment designed to fit the bitumen furnished. Some standard tanks and steam heaters were used. When these were not available or higher temperatures were desired, steel cube tanks were set up with external diesel oil burners. Cutback binders were made up by adding diesel fuel to the tank and mixing by circulating with a distributor pump. The usual cutback was 25% distillate and 75% bitumen. As the only other cutback available was 80-octane gasoline, we never attempted the manufacture of an RC with our crude equipment.

As the war progressed, we moved into new places and new conditions. But the American construction methods, equipment, and men continued to find the way to speedy and durable construction.

Perhaps an idea of the scope of airdrome construction in this theater can be obtained from the following summaries of the quantities involved in the construction of

SUBGRADE SHAPING AND COMPACTION PRECEDED PLACING OF CORAL BASE COURSE

Mokerang Airdrome on Los Negros in the Admiralty Islands. About 1,100 acres were cleared, including removal of 18,000 coconut trees. Topsoil stripped measured about 360,000 cu yd. Another 110,000 cu yd of grading was necessary, of which about 25% had to be blasted. The base course consisted of 172,000 cu yd of coral (20% blasted); the surface course, of sand, equaled 9,000 cu yd. About 180,000 gal each of prime coat and asphalt surface-course binder were required.

Wind Analysis for Airport Design

By SAMUEL B. SOLOT
LIEUTENANT COLONEL, AIR CORPS, U.S. ARMY

THE value of an airport is often limited by the poor orientation of its runways with respect to dangerous winds, which blow across the fixed paths of takeoff and landing more frequently than is necessary. Aircraft operations are not hindered by relatively high winds which parallel a runway; but when that parallelism does not exist, even lower speeds become critical. Major Solot shows how conventional methods for considering climate in airport design are not always effective, and with examples he describes a comprehensive method that has been confirmed by experience in the Middle East.

GENERAL practice among designers of airfields has been to construct the principal runway in the direction of the prevailing wind, and to add others to form an arbitrary symmetrical pattern. The "wind-rose" diagram has been a pernicious influence in this matter; planners have assumed that runways placed parallel to the longest barb on a wind rose serve aircraft operations most effectively. But that theory overlooks the fact that the prevailing surface wind for many stations is light—unimportant to flying safety. And at the same time it ignores the danger of certain violent winds; for when supercritical wind speeds originate from a low-frequency direction, their ominous nature is hidden within the rose diagram.

Incomplete planning is most serious when landing fields are spaced far apart. Then an airport cannot be "closed." Several fatal accidents have taken place in the Sahara during emergency blind landings when strong winds were blowing across the runway. These accidents might well be attributed to "engineering error."

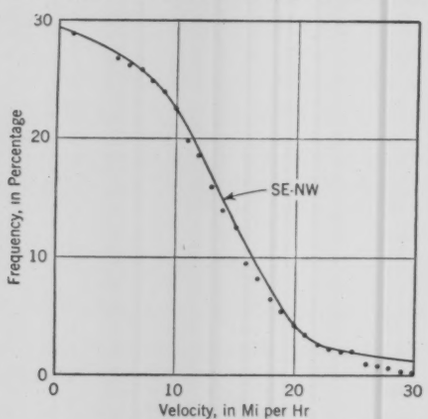


FIG. 1. SPEED-ANALYSIS CHART FOR SURFACE WINDS AT ABADAN, IRAN, FROM SE AND NW DIRECTIONS—ONE OF EIGHT SIMILAR CHARTS PREPARED

The principal reasons for inefficient layout of runways are two: (1) systematic local wind observations for new airport sites usually are scanty. Expert care and judgment in the study of wind data are especially necessary when data are scarce. (2) Indiscriminate use often is made of monthly and annual wind roses, which are misleading because they emphasize the prevailing, and not the critical, winds. Nevertheless, the experience of the 19th AAF Weather Squadron proves that meteorologists can determine the most efficient runway orientations from limited data.

As the building program at an airport proceeds, remedial measures become increasingly expensive. Hence, the more value a field attains as a capital investment through the years, the more inevitably do its basic design defects become frozen. For this reason it is important for the meteorologist to make his analysis as early as possible.

A practical analysis of runway design requires three distinct steps—becoming familiar with the problem from the engineer's viewpoint, sampling the data, and making a statistical analysis.

A conference with the responsible engineer is a necessity, so that the weatherman can explain the value of his reports and obtain information about the engineering problem involved. The weatherman must consider the representativeness of his data, looking for discrepancies caused by inadequate instrument exposure. He should critically examine detailed samples, interpreting them in terms of specific weather situations instead of climatological generalities. (This task requires a background of experience in the region.)

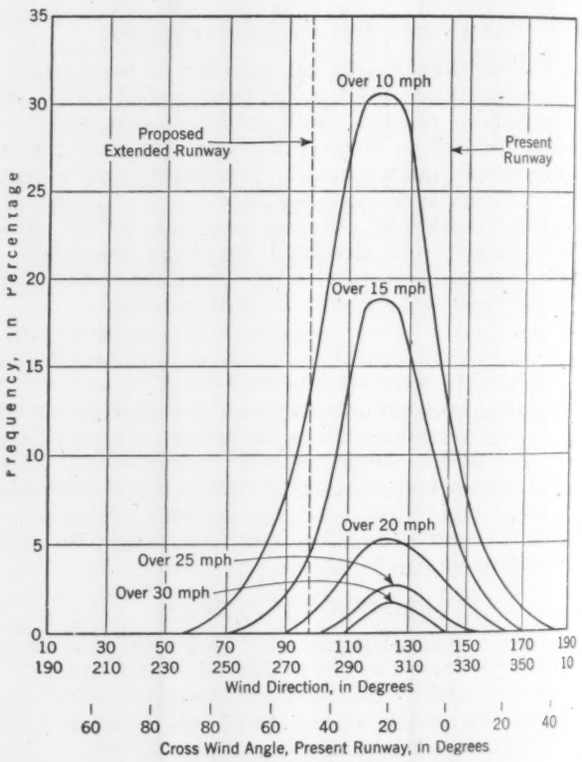


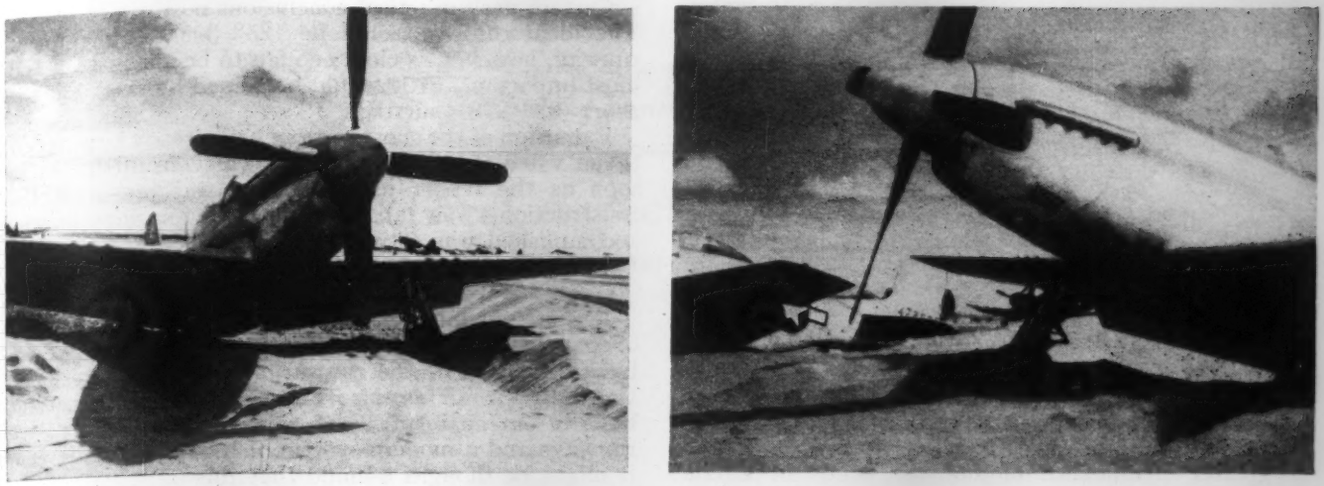
FIG. 2. VELOCITY-ANALYSIS CHART FOR WINDS AT ABADAN, IRAN, DURING JULY

The detailed procedures of the analysis should be adapted to the specific problem. In general, however,

TABLE I. SPEED DISTRIBUTION OF SE AND NW SURFACE WINDS COMBINED AT STATION "B," BASED ON 699 OBSERVATIONS

(1) Speed, miles per hr.	1–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
(2) No. of observations	45	18	8	20	14	10	21	9	12	6	9	6	5	3	1	1	7	1	2	3	0	1
(3) Cumulative total	202	157	139	131	111	97	87	66	57	45	39	30	24	19	16	15	14	7	6	4	1	1
(4) Frequency, %	29	23	20	19	16	14	12	9	8	6	6	4	3	3	2	2	2	1	*	*	*	*

* Less than 1%.



HIGH WINDS IN ARID REGIONS POSE SERIOUS PROBLEMS FOR AVIATION—VIEWS FOLLOWING SAND STORM AT ABADAN, IRAN

the first step is to tabulate four classifications of data (Table I) for each of eight wind directions. Runways are bi-directional of course, and so 16 points of the compass can be treated as 8 pairs of directions. The tabulation for each "bi-direction" should show: (1) successive speeds at intervals of one mile per hour over the whole observed range; (2) for each speed, the number of times that it was observed; (3) for each speed, the cumulative number of times that it or a higher value was observed; and (4) for each speed, the "limiting percentage frequency," which is obtained by dividing the cumulative total by the number of observations. For example, Table I shows that SE or NW winds of 10 miles per hr were recorded at Abadan, Iran, 18 times; that there were 157 occasions there when SE-NW winds were 10 miles per hr or over; and that their percentage frequency was 157/699, or 23%.

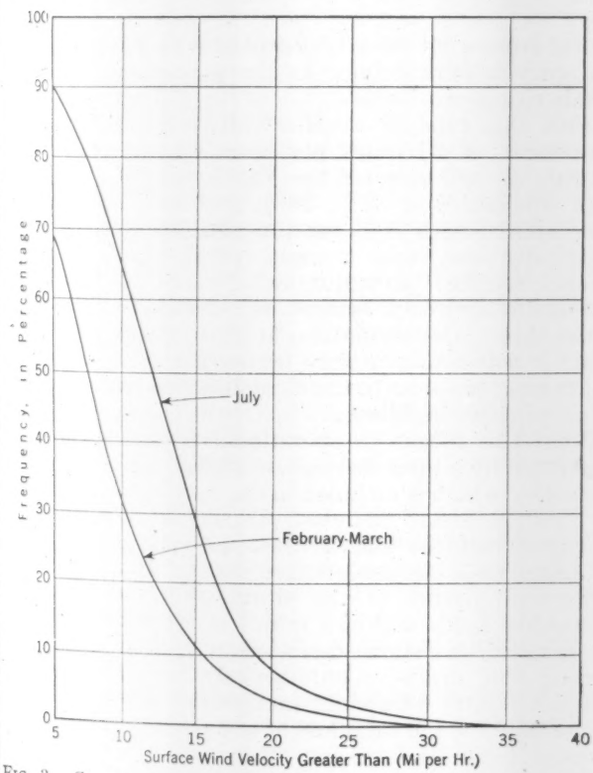


FIG. 3. COMPARATIVE FREQUENCY CHART FOR SURFACE WINDS AT ABADAN, IRAN, FROM ALL DIRECTIONS

Secondly, the data of (1) and (4) are applied to the construction of eight "speed-analysis charts" (Fig. 1). The speed (1), in miles per hour, is plotted against the percentage frequency (4) on graph paper. Then for each set of points a smooth curve is drawn through the highest points, so that none lie to the right of it. This is a so-called "enveloping curve," to which all plotted points will approach as the number of observations is increased.

Thirdly, the "velocity-analysis chart," Fig. 2 is drawn. Each of the eight curves already prepared determines a series of points on this chart, all along the ordinate corresponding to the particular wind direction, and each a limiting parameter for a standard speed. For example, Fig. 2 yields the points (135°, 22%), (135°, 13%), (135°, 2%), and (135°, 1%) for the 10, 15, 20, and 25-miles per hr curves respectively. Each curve of Fig. 3 has been drawn continuously through one of these points and its seven counterparts, one point from each bi-directional chart.

Finally, the analyst is ready to select the runway orientation that will have the highest percentage frequency of "safe" winds. The best runway orientation, then, from Fig. 3 is seen to be 120°–300°.

A runway analysis for an actual, typical airport in the Middle East is given in the following paragraphs to clarify the modifications of the general procedure which are appropriate for specific problems.

RUNWAY ANALYSIS FOR ABADAN, IRAN

The present runway is oriented at 144°–324°. There is also a short, unserviceable strip at 98°–278°. This report investigates the adequacy of the present runway, and evaluates the advantage to be gained by enlarging the short runway.

The file of Form 94 for Abadan covers two years—a substantial period. Furthermore, its data are representative and reliable. The average wind speed there is twice as great in summer as in winter. During the winter, the winds in the vicinity of the station usually are under the influence of the Arabian high-pressure cell; but weak, occluded Mediterranean cyclones occasionally invade this region from the west. Neither winter type is characteristically accompanied by strong, sustained wind speeds. In summer, on the other hand, there is a steep low-pressure area over Arabia. The wind direction at Abadan is extremely steady from the northwest (the northwest monsoon), and is strong enough to cause frequent dust storms. In Fig. 3 is shown the

TYPICAL AFTERMATH OF DUST AND SAND STORM, ABADAN, IRAN

far greater significance of summer winds in aircraft operations; and on that basis the runway analysis was confined to data for July, a typical summer month.

Table I and Figs. 2 and 3, presented to illustrate the general procedure, were originally prepared from data for Abadan. Figure 3 shows a normal distribution of speeds, with 300°–120° as an axis for lower velocities, shifting to 305°–125° as the speeds increase. The present runway is within 20° of the direction of maximum frequency.

To test the value of enlarging the short runway, Fig. 4 was constructed. The difference in cross-wind frequency between a one-runway (144°–324°) field and a two-runway (144°–324° and 98°–278°) field is used as a measure of the increased efficiency to be gained by lengthening the short runway. In this case the 10-mile per hr curve intersects the 22° cross-wind angle at 32%. This may be interpreted to mean that for winds over 10 miles per hr, having a cross-wind angle of less than 22°, a two-runway field is 32% more efficient than a one-runway field. However, this increase in efficiency is negligible because the limits of the cross-wind angle and the wind velocity are both non-critical. For more critical values the curves rapidly approach zero.

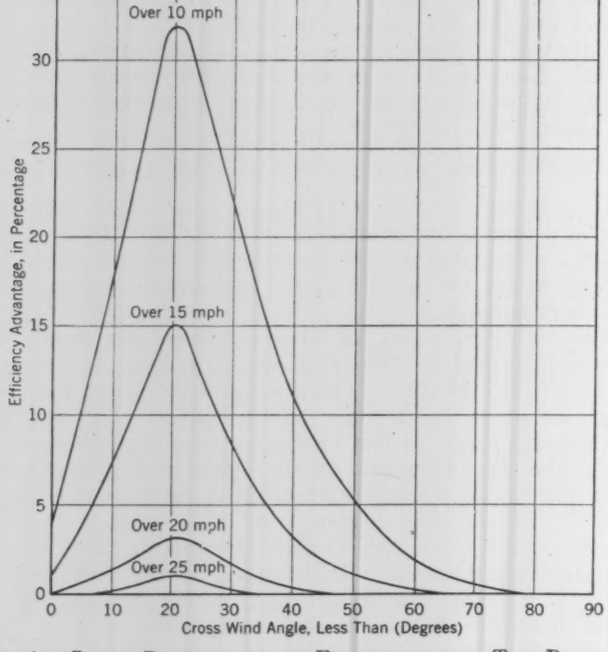


FIG. 4. CHART DEMONSTRATING EFFICIENCY OF A TWO-RUNWAY FIELD AT ABADAN, IRAN

Certain very practical conclusions now can be drawn. The ideal runway would be 125°–305°. The present runway, however, is close enough to be adequate. And most important, little would be gained by extending the short (98°–278°) airstrip.

Extension of the short runway had already been undertaken when the 19th Squadron was consulted; but as soon as the report just described was presented, the construction was abandoned. The saving thereby accomplished was estimated to be $100,000.

SITUATION AT PAYNE FIELD IN CAIRO

Perhaps the most glaring example of the shortcomings of conventional "wind-rose" methods of design is revealed by an analysis of the runway system at Payne Field, Cairo, Egypt. This airport is one of the most important links in our chain of world airways. With three large runways and a modern system of blind landing devices, it might be thought offhand that this airport should be perfectly safe. However, a detailed analysis of winds during emergency weather conditions proves quite the contrary. The efficiency of each runway for any given

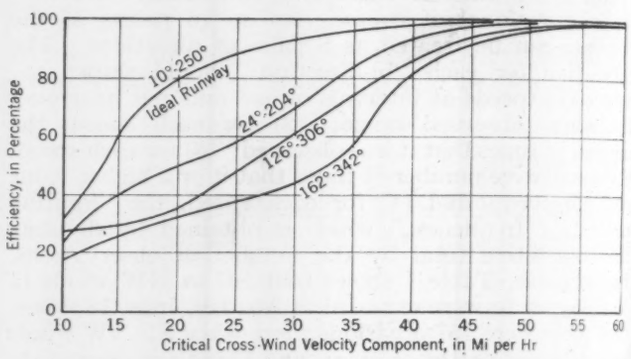


FIG. 5. RUNWAY EFFICIENCY CHART DURING EMERGENCY WEATHER CONDITIONS AT PAYNE FIELD, CAIRO, EGYPT

critical cross-wind velocity component is shown in Fig. 5. Efficiency is here defined as the percentage frequency of subcritical cross-winds.

With this type of weather conditions, a cross-wind component of 20 miles per hour may be considered critical. It will be noted that the three existing runways have efficiencies of 32%, 36%, and 50% respectively, as compared with 79% for the ideal runway. Characteristically the main runway (162°–342°), which is parallel to the "prevailing wind" and on which the instrument approach system was oriented, is the worst of the three. Unfortunately, at that late date (January 1945) it was found utterly impossible to fit a runway which was even close to the ideal direction without razing many valuable buildings.

What this means in operational terms may best be illustrated by a brief description of the conditions during one period which is included in the sample of data chosen for this particular analysis. During an intense storm at Payne Field in March 1944, the visibility was poor for more than 48 consecutive hours. Because of the widespread nature of the storm, there were no safe alternative fields within a radius of 800 miles. During the peak of this storm there was a total of six aircraft circling the airport simultaneously for several hours. The net results were eight fatalities, a large number of severe injuries, the total loss of one aircraft, and extreme damage to several others. Surviving pilot personnel were unanimous in the opinion that the greatest hazards were the violent cross-winds.

Engineers' Notebook

Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

A Geometrical Aspect of Failure Theories

By RICHARD JENNEY, M. ASCE

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MUCH work has been done to establish a general criterion for failure in triaxially stressed materials. This has resulted in a multiplication of theories, accompanied by a corresponding division of opinion. Practically speaking, nearly all theories of failure correspond fairly well with the mass of test data to which they purport to give general expression. In so far as a theory properly corresponds with triaxial test data, it may prove generally valid; but discussions based upon biaxial behavior alone leave much to be desired in the way of generality.

It has clarified the writer's thought on the subject to construct analytically a three-dimensional model based upon considerations of the symmetry of behavior which must prevail in a homogeneous material with respect to three axes. This results in the establishment of certain limitations to which any acceptable theory must be subject, and provides a convenient framework of reference for speculative thought. The space field used is that of pure number representing the ratio between actual stress and stress at the elastic limit, and the axes are axes of principal stress.

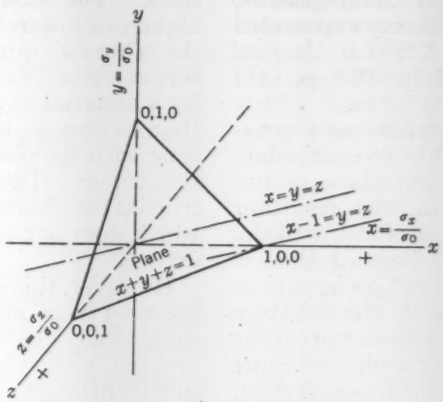

FIG. 1. TRIAXIAL DIAGRAM SHOWING SECTION OF PRISMATIC FIGURE OF STRESS

This approach requires the assumption of a perfectly homogeneous and isotropic material showing elastic behavior up to a definite point of yield, which, for our purposes, can be called elastic failure; and then attributing to this material certain ideals of behavior derived from such experimental data as seem to have bearing on the case. These postulates are:

1. Action of equal triaxial principal stresses of like sense does not produce failure within the range of known tests. (Experiments of P. W. Bridgman.)

2. The law of superposition of effects is valid for phenomena within the elastic range.

3. There is no observable qualitative difference between tension and compression, as regards the establishment of criteria for defining the limits of the zone of elastic behavior.

Referring to Fig. 1, if x, y, and z are axes of principal stress, it follows from Postulate 1 that line $x = y = z$, extended indefinitely both ways from the origin, defines the locus of stress conditions having no effect as regards elastic failure.

It then would appear that the degree of approach to the limit of elastic yielding might be measured as a function of the normal departure from this line of the point representing the stress condition under consideration. By Postulate 2, line $x - 1 = y = z$, for example, would represent a locus of conditions at the point of elastic yielding, and would constitute an element of the surface of a prism coaxial with $x = y = z$; and similarly for $x = y - 1 = z$, and $x = y = z - 1$. Three more such lines pass through points $-1, 0, 0$; $0, -1, 0$; and $0, 0, -1$. The surface of such a figure would delineate the boundary between elastic and plastic principal stress combinations.

It remains to study the possible right sectional shapes of this prismatic figure. A plane $x + y + z = 1$ will lie normal to the axis $x = y = z$ and will cut the x, y, and z axes at unity, representing limits of elastic behavior for simple compressive stresses. Since we are considering only homogeneous isotropic materials showing well-defined limits of elastic behavior, the three principal stresses may be interchanged in any of six ways without affecting the condition of the material as regards elastic failure. The right section of the prism enclosing safe values will therefore be symmetrical with respect to projections of the x, y, and z axes on the plane of the section, and with respect to normals to these projections. We must conclude, therefore, that the section will be either a circle; a hexagon; or some variant of a hexagon, such as a six-pointed star, or perhaps, but scarcely probably, some intricate snow-flake pattern.

Now, passing for the moment to the effect of this conclusion in the case of biaxial loading we have only to let $z = 0$ and view the trace of the prism on the x, y plane. We note:

1. The intersection of the prism with the x, y plane passes through points $\pm 1, 0$; $0, \pm 1$, and $\pm 1, \pm 1$.

a) If the section of the original prism were hexagonal, we should have a polygonal figure of six sides having vertices at the above points (Fig. 2*a*).

b) If the section of this original prism were circular, we should have an ellipse passing through these same points (Fig. 2*b*).

2. Any pre-failure combination of biaxial principal stresses will lie within one or the other of these figures,

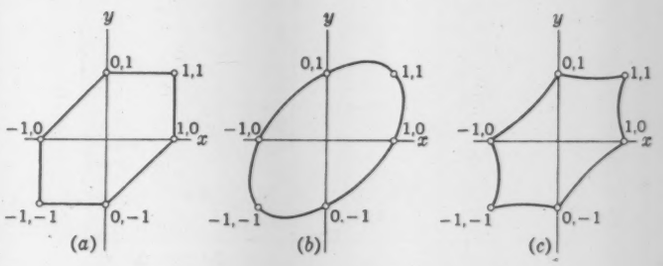

FIG. 2. VARIOUS SECTIONS OF PRISM OF STRESS PASSING THROUGH SIX POINTS

or some similar figure, such as Fig. 2 (*c*), passing through the same six points previously noted, and derived from a sixfold symmetrical right section of the solid prism.

3. Of the graphical representations of sixteen theories of failure, as prepared for comparison by Joseph Marin ("Failure Theories of Materials Subjected to Combined Stresses," TRANSACTIONS, ASCE, vol. 62, 1936, p. 1162), we find that only four meet the conditions that have been outlined, namely:

Type (*a*) { Maximum distortion
Maximum shear (Coulomb and Guest)

Type (*b*) { General shear theory (special case of Mohr's theory for $a = 1.00$)
Maximum shear strain-energy theory of Von Mises, Hencky, and Huber

Furthermore, the theory of Schleicher (*Bauingenieur*, 1928, p. 253), and the octahedral shear theory expounded by A. Nadai ("Theories of Strength," A.S.M.E. *Journal of Applied Mechanics*, Vol. 1, No. 3, July 1933, p. 111) both fit the ellipse of Fig. 2 (*b*) exactly.

The writer therefore concludes that whatever the nature of the causes of failure, whether it be overstressing, overdistortion, overloading in shear on any plane, or any combination of these possible criteria, the resultant graphical representation must at least conform with the limitations stated in (1) preceding. Beyond this, it would seem to be solely a matter of personal preferance as to which of the two figures best represents the behavior of ductile materials, as tests apparently have not so far shown sufficient consistency to narrow the choice to one or the other. This being the case, it would appear logical, and certainly "prettier," to view the prism of pre-failure cases of triaxial stress as a cylinder having a radius of $\sqrt{2/3}$, and to regard the approach to failure as measured by the proportionate distance of the point representing the stress condition from the axis to the surface of the cylinder. This view would also harmonize perfectly with the octahedral shear theory, which, for simplicity of expression and strong logical appeal, seems at present to lead the field. In fact, it should be noted that the equation for the cylindrical surface just discussed is

$$(x - y)^2 + (y - z)^2 + (x - z)^2 = 2$$

which is, in effect, the fundamental equation, in stripped-down form, of the octahedral shear theory for the general triaxial case.

This idea of a "safe zone" in three dimensions can be expanded speculatively in a number of interesting directions. For example, a non-isotropic material having higher, or lower, failure limits along one axis than along the other two might possibly be represented by the same sort of cylinder coaxial with a line $x = y = Kz$. Then, for a material having higher failure limits in compression than in tension, the solid figure might possibly become a cone with its vertex on the $x = y = z$ line in the all-tension octant. This would imply a limiting value for equal triaxial tensile stresses at the vertex of the cone, an idea which does not conflict with what one might reasonably expect.

However, this sort of more or less fanciful thinking can serve no more useful purpose than to indicate the directions along which corroborative testing work might well proceed, and to block out as irrelevant much two-dimensional theorizing.

A Graphical Solution for Flood Routing Problems

By H. M. CHENG
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A GREAT many different methods have been developed to solve flood routing problems. Among them, some are approximate—suitable only for preliminary estimations—and others, being more complicated, give more exact results. Since the equation involved in this problem cannot be solved generally by mathematics (except by trial and error), use has been made of graphs to obtain the solution. Owing to the various auxiliary curves introduced, there are also a number of different forms for the graphical solution.

Various methods have been designed to facilitate the operation. Their respective merits are often justified by different design conditions. There are some methods using both graphs and tables, others using a mass curve or several auxiliary storage curves, and some recent ones using a specially made slide rule or a nomograph. The great variation in the methods in use at the present time tends to point to the difficulties that have been experienced in formulating a simple and accurate method for solving this problem. The method here described may be helpful to engineers who have to deal with such problems.

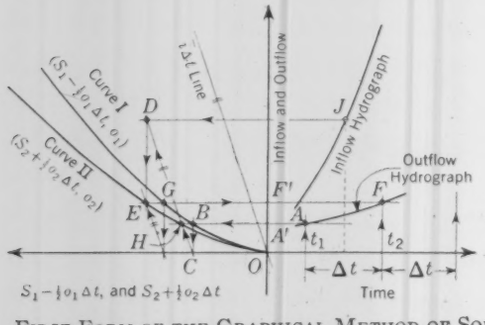


FIG. 1. FIRST FORM OF THE GRAPHICAL METHOD OF SOLUTION

In this article, subscripts 1 and 2 refer to the beginning and end of the routing interval, and a bar refers to the mean value. The other nomenclature used is as follows:

t = time
s = rate of storage
o = rate of outflow from the reservoir
i = rate of inflow to the reservoir
S = accumulated volume of storage
O = accumulated volume of outflow
I = accumulated volume of inflow
h = elevation

The basic equation for flood routing computations is

$$\text{Inflow} = \text{outflow} + \text{storage}$$

or during a short interval of time, Δt,

$$\bar{i}\,\Delta t = \bar{o}\,\Delta t + \Delta S$$

or

$$\bar{i}\,\Delta t = {}^1/_2(o_1 + o_2)\,\Delta t + S_2 - S_1$$

$$\bar{i}\,\Delta t + S_1 - {}^1/_2\,o_1\Delta t = S_2 + {}^1/_2\,o_2\Delta t$$

This equation is then solved graphically.

In Fig. 1, the first form of the method, curves I and II, representing $S_1 - {}^1/_2\,o_1\Delta t$, and $S_2 + {}^1/_2\,o_2\Delta t$, respectively,

are drawn on the left-hand side of the graph both as a function of outflow, o. The inflow hydrograph is drawn on the right-hand side, and also a number of t-lines drawn at regular intervals of Δt. An inclined line which gives the relation of $\bar{\imath}$ and $\bar{\imath}\,\Delta t$ is drawn through the origin. Starting at a point A on the outflow hydrograph, where

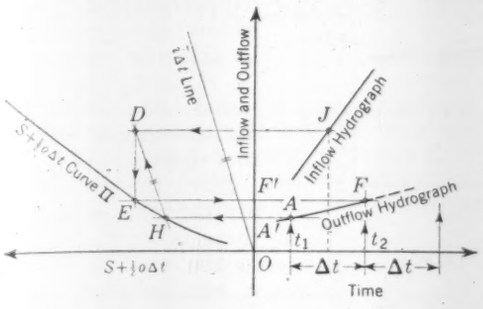


FIG. 2. SECOND FORM OF GRAPHICAL SOLUTION USES ONLY STORAGE CURVE II

the outflow is o_1, and the time t_1, draw a horizontal line to meet curve I at B. Project B to C. Draw CD, which is parallel to the $\bar{\imath}\,\Delta t$ line, to meet the horizontal drawn from the average inflow, J, at D.

Then draw a vertical from D, intersect curve II at E. Draw a horizontal line EF, meet the t_2 line at F. Point F is the second point on the outflow hydrograph. The process is repeated by drawing a vertical from G, which is the intersection of EF and curve II. The explanation of this process is simple. The length of $A'B$ is equal to $S_1 - {}^1/_2\, o_1 \Delta t$, and the length of $F'D$, which is equal to $S_2 + {}^1/_2\, o_2 \Delta t$, also represents the value of $\bar{\imath}\,\Delta t + (S_1 - {}^1/_2\, o_1 \Delta t)$.

From Fig. 1, it can easily be seen that the inclined line CD meets the horizontal line AB at H, which is also a point on curve II. This will be a very good check for this method, and furthermore it leads to a simpler form of construction. In Fig. 2, the second form of the graphical method, curve I is omitted. Start from the same point A, draw a horizontal line to meet curve II at H. Draw HD, which is parallel to the $\bar{\imath}\Delta t$ line, to meet the horizontal drawn from the average inflow J, at D. From D, draw a vertical to meet curve II at E. Draw a horizontal line from E to meet the t_2 line at F. Point F is the second point on the outflow hydrograph.

This can be explained as follows: The distance $A'H$ equals $S_1 + {}^1/_2\, o_1 \Delta t$, and the distance $F'E$ equals $S_2 + {}^1/_2\, o_2 \Delta t$. The horizontal distance between H and E is equal to $(\bar{\imath} - o_1)\,\Delta t$. Equating these distances, we have:

$$S_2 + {}^1/_2\, o_2 \Delta t = (\bar{\imath} - o_1)\,\Delta t + S_1 + {}^1/_2\, o_1 \Delta t = \bar{\imath}\,\Delta t + (S_1 - {}^1/_2\, o_1 \Delta t),$$

which agrees with the flood equation.

Since both the curves I and II can be constructed from an S-o curve, this method can be worked out equally successfully by using an S-o curve. In Fig. 3, the third form of the method, an S-o curve is drawn on the left-hand side. In addition to the $\bar{\imath}\,\Delta t$ line, two more inclined lines representing the relations between ${}^1/_2\, o\Delta t$ and $-{}^1/_2\, o\Delta t$ and o, respectively, are drawn. Starting from a point on the outflow hydrograph A, draw a horizontal line to meet the S-o curve at B. Project B to C. Draw CD, which is parallel to the ${}^1/_2\, o\Delta t$ line, to meet the extension of the horizontal line AB at D. Draw DE parallel to the $\bar{\imath}\,\Delta t$ line, and meet JE at E. Project E to F. Draw FG parallel to the $-{}^1/_2\, o\Delta t$ line to meet the S-o curve at G. Draw a horizontal line from G to meet the t_2 line at H. Point H is the second point on the outflow hydrograph.

The explanation is as follows: The distance LG is equal to ${}^1/_2\, o_2 \Delta t$, and the horizontal distance between E and D is $(\bar{\imath} - o_1)\,\Delta t$. The horizontal distance between G and D is, therefore, equal to $(\bar{\imath} - o_1)\,\Delta t - {}^1/_2\, o_2 \Delta t$. The distance BD equals ${}^1/_2\, o_1 \Delta t$, and the distances $A'B$ and $H'G$ equal S_1 and S_2, respectively. Equating these distances, we have

$$S_1 + {}^1/_2\, o_1 \Delta t + (\bar{\imath} - o_1)\,\Delta t - {}^1/_2\, o_2 \Delta t = S_2$$

or

$$\bar{\imath}\,\Delta t + (S_1 - {}^1/_2\, o_1 \Delta t) = S_2 + {}^1/_2\, o_2 \Delta t$$

which also agrees with the flood equation.

The new method has several characteristics. First, the operation is carried on along a series of continuous lines, thus greatly facilitating the operation and saving both time and work. No laying off of distances, and no computation tables will be needed. Secondly, the preparatory work is reduced to a minimum, especially for the second and third forms, where only two or three curves need be plotted from the available data, and no complicated calculations are involved. Thirdly, the accuracy of the result can be adjusted within allowable limits by choosing a suitable size of sectional paper. An ordinary size of paper, however, will be satisfactory for most cases. Generally the construction lines on the graph meet at fairly wide angles, so that the intersections are well defined.

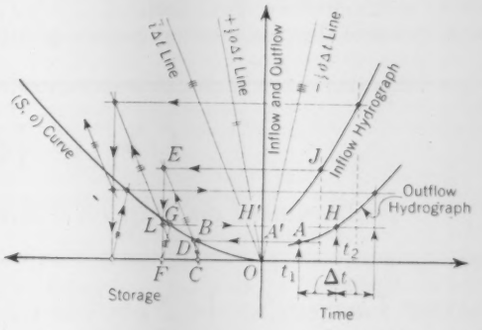


FIG. 3. SOLUTION USING THE STORAGE-OUTFLOW CURVE

An illustrative example, using the second form of the new method to find the reservoir stage variation curve,

TABLE I. TABULAR QUANTITIES USED IN EXAMPLE SHOWN IN FIG. 4

h	o	S	$o\,\Delta t$	$S + {}^1/_2\, o\,\Delta t$	$S - {}^1/_2\, o\,\Delta t$
0.5	28	0.148	0.101	0.198	0.098
1.0	79	0.840	0.285	0.983	0.698
1.5	146	2.310	0.522	2.57	2.049
2.0	224	4.740	0.806	5.143	4.337
2.5	313	8.300	1.127	8.864	7.736
3.0	411	13.020	1.480	13.760	12.280

FOR Δt = 1 HR

$\bar{\imath}\,\Delta t = 3{,}600\bar{\imath}$		${}^1/_2\, o\,\Delta t = 1{,}800\, o$	
$\bar{\imath}$	$\bar{\imath}\,\Delta t$	o	${}^1/_2 o\,\Delta t$
100	0.360	100	0.180
200	0.720	200	0.360
300	1.080	300	0.540
400	1.440	400	0.720

is given in Fig. 4, the tabular quantities for which are given in Table I. The characteristics of the reservoir and spillway are as follows:

$$o = 92\, h^{3/2}, \text{ in cu ft per sec}$$

$$S = 0.840\, h^{5/2}, \text{ in million cu ft}$$

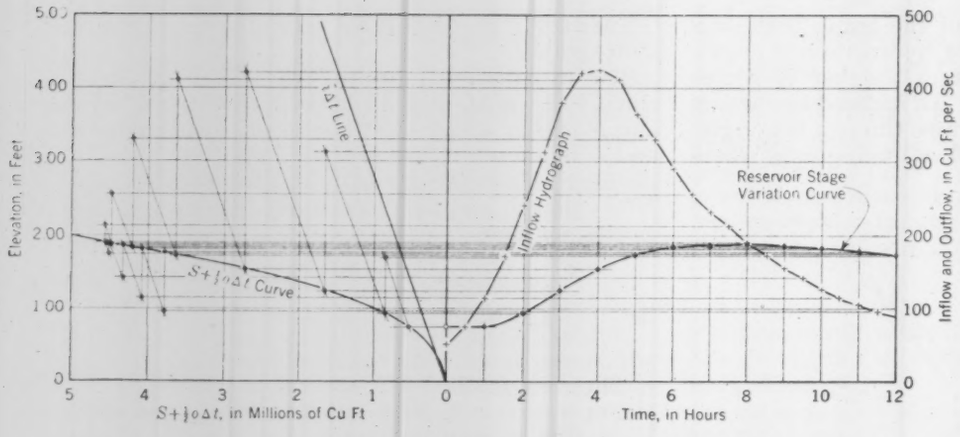

Elevation, in Feet
Inflow and Outflow, in Cu Ft per Sec
$S+\frac{1}{2}o\Delta t$, in Millions of Cu Ft
Time, in Hours
$i\Delta t$ Line
Inflow Hydrograph
Reservoir Stage Variation Curve
$S+\frac{1}{2}o\Delta t$ Curve

FIG. 4. TYPICAL HYDROGRAPH ILLUSTRATING USE OF GRAPHICAL METHOD

mon with the trial-and-error method. This is that the time interval Δt can be changed at different steps. Many engineers prefer to have a shorter time interval when the outflow is nearing its maximum. This requirement cannot be satisfied by any other graphical method. In the new method, this can be done by providing additional $\bar{i}\Delta t$ and $\pm\frac{1}{2}o\Delta t$ lines on the graph, corresponding to a shorter interval Δt.

Since the preparatory work for the new method is small, there is very little difference in the routing work between a number of floods and one single flood. However, when a great number of floods are to be routed for the same reservoir, sectional tracing paper can be used. The storage curves are drawn on the left. A number of prints can then be obtained, and different inflow hydrographs drawn on the right. The outflow hydrographs can be traced alongside without any further calculations.

The first and second form of the new method can also be used to work out water-surface variation curves. In this case, the vertical axis also represents the water-surface elevation. All the other processes remain the same, except that the $S \pm \frac{1}{2}o\Delta t$ curves are plotted as functions of water-surface elevation.

The third form of the new method has one point in com-

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Testing Large-Scale Models of the Birchenough Bridge

TO THE EDITOR: I have been reading the first of Dr. Steinman's series of articles on "Design of Bridges Against Wind," in the October 1945 issue of CIVIL ENGINEERING. I was interested to note that, on page 470, Dr. Steinman refers to the wind-tunnel tests which he made on large-scale models of the Birchenough Bridge. We found these results of the greatest interest, although the small size of the tunnel limited the scope of the tests we should have liked to make.

It is not quite correct to say that no measurements of the vertical lift were taken. These measurements were taken, but only for the horizontal winds, and were found to be negligible. No tests were made with the bridge tilted slightly out of the vertical to discover the effect of winds blowing at an angle to the horizontal above or below the deck.

London, England

H. SHIRLEY SMITH, M. ASCE
Cleveland Bridge and Engineering Company, Ltd.

Bridge Models Tested in Moving Water

DEAR SIR: Dr. Steinman's recent series of articles, in CIVIL ENGINEERING, on the aerodynamics of bridge structures, with his plea for more extensive fundamental wind-tunnel tests of structural elements, brings to mind the possibilities of still another type of solution. This approach to the problem lies in the test of complete scale models while submerged in moving water.

The advantages of the shift in fluid lie in an approximate simulation of conditions at much slower and more manageable speeds and with much larger and more measurable forces. This is permissible in view of the inherent viscosity and density properties of water and air, provided the Reynolds criterion is considered applicable to the phenomena.

This interchange of fluid media is neither invalid nor novel, as evidenced by successful studies of the influence of winds on airship models in a water tank at the Guggenheim Airship Institute in Akron, studies of aircraft models in the German water tunnel at Göttingen, and structural tests of aircraft conducted by submerged towing of actual planes in the German model basin in Hamburg. Conversely, submarine models were tested in the Massachusetts Institute of Technology wind tunnel as long ago as 1916.

Facilities for towing models through still water are available at a number of places in the United States, the largest being located at the Navy Department's David Taylor Model Basin at Carderock, Md. In addition to conventional towing basins, this installation has water tunnels and a large circulating water channel, which permit model studies comparable to those in wind tunnels—that is, with the model at rest and the fluid in motion.

The possibilities of such structural aerodynamic studies may be worthy of investigation.

Carderock, Md.

JOHN F. RIPKEN, Jun. ASCE
Hydraulic Engineer, Navy Dept. David Taylor Model Basin

The Osaka Subway

DEAR SIR: Some time ago articles on the Tokyo and Osaka subways were published in CIVIL ENGINEERING ["The Tokyo Underground Railway," by Y. Totake (November 1935), and "The Osaka Underground Railway," by Y. Totake (April 1937)]. As an American soldier now stationed in Japan south of Osaka, I have had occasion both to ride in and examine the subway in that city.

The subway is in operation and carrying all the traffic it can handle; the lines during the rush hours reach well into the street above the busier stations. They are operating two-car trains at present, rather than the four-car trains I am told were formerly in use. Apparently a great deal of their equipment was put out of commission during the war. The stations are becoming dirty and smelly.

Wakayama, Japan

CPL. R. A. OLMSTED
H. and S. Co., 380 Engrs.

SOCIETY AFFAIRS

Official and Semi-Official

1946 Spring Meeting to Be in Philadelphia, April 17-19

Hotel Bellevue Stratford to Be Headquarters

PLANS ARE rapidly being completed for the 1946 Spring Meeting of the Society, which will be held in Philadelphia April 17, 18, and 19, 1946. Under the chairmanship of Francis S. Friel, president of the Philadelphia Section, fourteen different committees have been assigned duties and responsibilities for meeting arrangements.

General Session

The meeting will be opened on Wednesday morning, April 17, by Mr. Friel, and he will introduce Mayor Bernard Samuel of Philadelphia and Governor Edward Martin of Pennsylvania, who will welcome the visiting engineers to the city and state. Society President W. W. Horner will respond to these welcomes and be followed by the principal speaker of the morning session, Edward Hopkinson, Jr., chairman of Philadelphia's City Planning Commission.

Technical Division Sessions

Wednesday afternoon and all day Thursday will be devoted to sessions of the Technical Divisions, as follows:

WEDNESDAY, April 17, 1946—AFTERNOON

Highway Division
Sanitary Engineering Division
Structural Division

THURSDAY, April 18, 1946—MORNING

Power Division
Sanitary Engineering Division
Soil Mechanics and Foundations Division

THURSDAY, April 18, 1946—AFTERNOON

Construction Division
Surveying and Mapping Division
Waterways Division

Social and Entertainment Features

In addition to the technical sessions, the Philadelphia local committee is busy completing its arrangements for entertaining visiting members, ladies, and guests during the meeting. Present plans include the following:

Luncheon—Wednesday noon, April 17.

Dinner and Dance—Wednesday evening, April 17.

Ladies Tea and Entertainment—Thursday afternoon, April 18.

All-Day Excursion—Friday, April 19. Two trips are being planned, one of general interest, and the other to include visits to points of technical interest. Details will appear in the April issue of CIVIL ENGINEERING.

Advance Registration

Summary programs and advance registration cards will be mailed to members resident in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia, and Virginia, and to all other members who request them.

Requests for tickets by advance registration may be accompanied by remittance. Remittances will be acknowledged, but tickets will not be mailed. Instead, they will be held to be picked up at the Advance Registration Desk at the time of arrival at Meeting Headquarters. Orders for tickets by mail should not be made after April 10.

Tickets to all functions will be on sale at the Registration Desk in the Hotel Bellevue Stratford.

Hotel Accommodations

A block of rooms has been reserved at the Bellevue Stratford Hotel, the meeting Headquarters. Members attending the Spring Meeting should make their hotel reservation as early as possible. When writing to the Bellevue Stratford requesting a reservation, members should mention that the room is required for attendance at the Spring Meeting, ASCE.

If you are planning now to attend the meeting, it is recommended that you make an **immediate** request for a room reservation. Confirmation of reservations will be made directly by the hotel.

Final Program

See CIVIL ENGINEERING for April for the final program of the Spring Meeting.

The Photo-Illustrators

VIEW OF PHILADELPHIA FROM BENJAMIN FRANKLIN PARKWAY

Collective Bargaining by Engineers in Los Angeles, Calif.

Comment by WILLIAM N. CAREY, SECRETARY AND EXECUTIVE OFFICER

A GROUP of Los Angeles engineers have been boiling merrily in the collective bargaining pot for several months. The National Labor Relations Board, under date of January 17, 1946, Case No. 21-R-2811, has taken the pot off the fire by a "Decision on Direction of Election." This decision recently has been made available for study at Society Headquarters. Although the decision brought out nothing new in NLRB procedures, it did develop interesting and instructive points which should be better understood by engineers.

ENGINEERS UNITE FOR PROTECTION

Early in 1945 the Utility Workers Union of America, CIO, herein called the CIO, showed signs of organizing the "white collar" workers of the Southern California Gas Company in Los Angeles. The CIO already was the recognized bargaining unit among many of the employees of the company. A number of professional engineer employees of the company looked with active disfavor on the prospect of their being made part of the CIO local. Naturally, the CIO paid no attention whatever to the wishes of the professional engineers, but claimed bargaining jurisdiction to include them. Members of the ASCE and of other national and local engineering societies were among the men involved.

Fortunately for the engineers, the ASCE men in the company were not entirely ignorant of the problem of collective bargaining among professional engineers. Our Board of Direction, through its Committee on Employment Conditions, items in CIVIL ENGINEERING, and ASCE Manual No. 26, had, since October 1943, awakened our membership to the question and had transmitted basic information to the membership. When the engineer employees of the Gas Company saw the cloud of CIO unionism about to roll over them against their will, the ASCE men among them knew what was required in order to try to obtain for professional engineering employees the right to speak for themselves regarding conditions of their own employment. With ASCE member leadership, the Southern California Professional Engineering Association, hereafter called the Association, was formed. The Association promptly claimed the right to represent the professional engineering employees in collective bargaining with the company. Except for the fact that some members of the Association also were members of the ASCE, there was no connection whatever between the two organizations.

THE ISSUE JOINED

Both the CIO and the Company refused to recognize the Association, whereupon the Association, by petition to NLRB, alleged "that a question affecting commerce had arisen concerning the representation of employees of the Southern California Gas Company" and requested that NLRB hear the petition. The Company and the CIO moved separately for dismissal of the petition; these motions were denied by NLRB. Hearings were held before an NLRB Examiner in Los Angeles, the transcript reviewed by NLRB, and a decision reached relating to the dispute.

It might be well to emphasize, for the benefit of the freshman class, the fact that NLRB does not "recognize" a collective bargaining unit or group simply on request. In order to bring NLRB into the picture, there must be a dispute or disagreement concerning employees and the conditions under which they are employed. The dispute must be of such a nature that NLRB will recognize it as affecting interstate commerce or likely to affect it. Then, and then only, will NLRB act to resolve the dispute; then, and then only, will NLRB give official decision as to appropriateness, scope, or representation of a bargaining unit.

A unit may bargain prior to official recognition by NLRB. Many bargaining units and groups have done so and continue to engage in collective bargaining procedures without benediction by NLRB. Such units, however, are overly vulnerable until, through the resolution of some dispute, NLRB has baptized them in the turbid waters of the Wagner Act and they have thus become officially recognized as truly legitimate children in the family of labor unions. No labor union ever is completely invulnerable to attack, although by successive winning of disputes through NLRB decisions some unions have become as protectively dipped as Achilles.

COMPANY'S CONTENTIONS MET

In the case here discussed, and in all such cases, NLRB had first to determine if the company was engaged in commerce within the meaning of the National Labor Relations Act, i.e., in interstate commerce. The company contended that its business was not interstate commerce. The fact that the Company purchases pipe, meters, regulators, and similar items of substantial value from without the state furnished adequate grounds for the NLRB conclusion that the Company is engaged in commerce within the meaning of the Act.

The Company refused to recognize the Association as the exclusive bargaining agent for certain employees, one contention being that the Association did not represent a substantial number of employees. The CIO made a similar contention. The point here was an attempt to show that the number of employees admittedly under the Association's banner was so small, in comparison with all the employees involved, that the Association was not sufficiently substantial to have any effect worth recognizing with regard to collective bargaining matters. The record showed that there were approximately 100 employees in the unit set forth in the Association petition and approximately 150 employees in the unit asserted by the CIO as appropriate. In neither case had the Association or the CIO signed up all the employees claimed by each as properly in one unit or the other. The Association had 54 signers and the file is silent as to the number of actual signers the CIO had. The Board found, contrary to the contention of the Company and the CIO, that the interest of the Association was substantial.

NLRB, having concluded that the Company was engaged in interstate commerce and, in accordance with petition by the Association, the free flow of commerce was threatened because of a prospective dispute involving employees and, having decided that the interests of the Association in the dispute were substantial, the question then before NLRB for decision was that of the appropriate bargaining unit.

RELATION TO ORGANIZATION SETUP

The Company operates with six separate "divisions," some of them geographically separated from the Central Division in which this particular dispute arose. The Association sought a unit of non-supervisory "professional engineering employees" engaged at the Central Division of the Company. The Association described its unit in terms of categories of employees, seeking to include all non-supervisory employees engaged as designers, engineer assistants A and B, junior engineers, office engineers, staff technicians, technical assistants, air-conditioning engineers, industrial gas engineers, service engineers, office supervisors, petroleum engineers, technical service engineers, estimating engineers, and research chemists.

The Company asserted that the unit was inappropriate in that it included confidential and managerial employees as well as employees not engaged in an engineering or technical capacity, and failed to include technical employees whose work is closely associated with, and performed under the same working conditions as, that of the "professional engineering employees." In addition, it contended that the unit should be system-wide in scope. More particularly, the Company held that the unit should include draftsmen, laboratory assistants, laboratory technicians, and construction detailers, who are currently unrepresented for the purposes of collective bargaining. It also held that there should be included some employees who are currently represented by the CIO, such as engineering aides and industrial service men, who, the Company asserted, were engaged in a technical capacity.

SCOPE DEFINED

The CIO agreed with the Company with respect to the inappropriateness of the proposed unit because of the failure to include therein certain unrepresented technical employees; however, it disagreed with the Company to the extent that the Company would include employees whom the CIO now represents. Both Labor organizations disagreed with the Company with respect to the confidential status of specific employees in the proposed

unit, and disagreement also existed among the parties as to the supervisory status of particular workers.

The Association, which claimed only "professional engineering employees" of the Central Division, refused to amend its petition to system-wide when given an opportunity to do so. The NLRB finally concluded that a unit limited to employees of the Central Division was appropriate. It should be noted also that CIO already represented two bargaining units in the Central Division, i.e., "production employees" and "maintenance employees."

BOARD FINDINGS ARE ILLUMINATING

The deliberations of the Board regarding the composition of the proposed unit in dispute are informative. Its findings and footnotes on this subject warrant quoting verbatim and study by professional engineers interested in this subject. Under a heading, "The general composition of the unit," the Board stated:

"As previously noted, the Association seeks a unit of 'professional engineering employees,' contending that these individuals have interests and problems differing from other employees of the Company, including those engaged in 'non-professional' technical, or 'non-professional' engineering duties; it asserts that the 'professional engineering employees' can best be represented by an organization aware of their problems which 'vary considerably with the *individual*.' It is not clear, however, what the Association means by a 'professional engineering employee.' From the evidence adduced at the hearing, *individuals* may qualify as such if they have received an engineering degree from a recognized school of learning or are able to be and actually are engaged in 'creative' work pertaining to the 'control and conversion of forces and materials to use in structures, machines and products.' Thus, apparently, the Association recognized that experience may properly take the place of education for the purpose of coming within the definition of a 'professional engineering employee.' However, the Association reserves the right to pass upon the qualifications of applications for membership upon an *individual* basis. It appears that the Association seeks a unit of individuals rather than a group of employees engaged in similar or related work, and would exclude therefrom persons who do not have the qualifications of a 'professional engineering employee,' as interpreted by its membership committee. In the *Curtiss-Wright* case, we had occasion to pass upon and reject a similar contention with respect to a bargaining unit, stating:

"'A unit . . . delineated upon the basis of the scholastic (or equivalent) history of *individual* employees rather than on the basis of their function, would in our opinion be unworkable and inappropriate for collective bargaining purposes.'"[11]

"For the reasons set forth in the *Curtiss-Wright* case, which obtain here, we shall delineate the unit hereinafter found appropriate in functional terms."

The real "cracker" on the whip represented by the above long quotation of statement and notes deserves rereading. It is:

"A unit . . . delineated upon the basis of scholastic (or equivalent) history of *individual* employees rather than on the basis of their function, would in our opinion be unworkable and inappropriate for collective bargaining purposes."

The Board in this case delineated the unit "in functional terms" and not on the basis of "professional engineering terms." It was careful to point out that the only cases where it has recognized as "appropriate" units of "professional" employees is where the units of professionals happened to be functional in scope.

The Board in its decision then proceeded to mix sub-professional with professional employees in line with delineating a unit on a truly functional basis. There were many contentions between the Company and both the CIO and the Association regarding status of employees as to whether or not they were supervisory, confidential, or part of management.

Illustrating the basis for mixing sub-professionals with professional engineers, the following is quoted from the Board decision. The numbered classifications mean little without the complete record but the meaning of the quoted paragraphs is clear enough.

"The record indicates that laboratory assistants and laboratory technicians perform duties comparable to and closely associated with those of technical assistants and research assistants; that Draftsmen are engaged in duties similar to those of senior draftsmen, the differences in the work of these two classifications of employees being simply one of degree of complexity; and that construction detailers do the same type of work as engineering assistants B. We are of the opinion, therefore, that no technical and engineering unit of employees of the Company can be complete without the inclusion of employees in these classifications. Accordingly, we shall include them."

COMPOSITION OF GROUP

On the determination of status, the Association lost a large number of professional engineer employees they had claimed but gained sub-professional employees. The quotations to follow will serve to indicate NLRB reasoning in excluding and including certain classes of employees in the unit. Several quotations from the Board decision on this aspect of the dispute follow:

"*Designers*—The Company contends that 1 of its 14 designers is a supervisory employee. This employee (job description 12) assigns work to, and coordinates the work of 4 other designers and 2 senior draftsmen. He makes personnel ratings, and his recommendations with respect to his subordinates carry considerable weight. We shall exclude this designer as a supervisory employee, but include the remaining designers."

"*Engineering Assistants A*—The Company contends that 13 of the 16 engineering assistants A are supervisory employees (job descriptions 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29, and 32), and that only 3 are not (job descriptions 27, 30, and 31). The record indicates that the 13 engineering assistants A alleged to be supervisory employees supervise the work of several subordinates; they either discuss the job performance of subordinates with their superiors, make personnel ratings with respect to their subordinates, or do both. Recommendations of these 13 employees affecting the status of their subordinates are accorded substantial weight by the Company. We are of the opinion that they are supervisory employees and shall exclude them."

"*Office engineers*—The Company asserts that certain office engineers (job descriptions 53, 57, 62, and 63) are supervisory employees; that others (job descriptions 54, 55, 56, 58, 60, 61, and 65) are confidential employees; and that some office engineers (job descriptions 59, 62, 63, 64, and 66) do not perform duties of a technical or engineering nature."

"The record indicates that each of the office engineers alleged to be a supervisory employee supervises the work of several subordinates and gives them efficiency ratings. In addition, their recommendations with respect to their subordinates are accorded considerable weight by the Company. We find that they are supervisory employees and shall therefore exclude office engineers in job descriptions 53, 57, 62, and 63."

"However, we cannot agree with the Company that the office engineers alleged to be confidential are, in fact, confidential

Changes in Membership Certificates

In case some may have missed the announcement in the February issue, page 83, the attention of Society members is again called to the fact that the trim size of membership certificates has been reduced from 17 by 20 inches to 10½ by 13 inches. This applies to all types of certificates, including those for Members, Associate Members, and Affiliates.

In connection with this change a new policy was initiated of issuing certificates to Juniors also, at a charge of $1.50 each. Juniors desiring to secure certificates should request them in writing from Society Headquarters, 33 West 39th Street, New York 18, N.Y.

[11] We distinguish the cases in which we have recognized the appropriateness of units of 'professional' employees since in those cases the units found appropriate were functional groupings: *Matter of Aluminum Company of America, The Aluminum Cooking Utensil Company* (Amendment to Decision and Direction of Election), 62 N.L.R.B., No. 48; *Matter of Lockheed Aircraft Corporation*, 58 N.L.R.B. 1188; *Matter of General Electric Company*, 57 N.L.R.B. 81; *Matter of Radio Corporation of America, RCA Victor Division*, 57 N.L.R.B. 1283; *Matter of Shell Development Company, Inc.*, 38 N.L.R.B. 192. See also *Matter of Neches Butane Products Company*, 61 N.L.R.B. 1194.

employees within the meaning of our usual definition of 'confidential employees.' None of them is concerned with employer-employee relationships, as such, or have access, in the normal course of their duties, to confidential information directly pertaining thereto. Accordingly, we shall include within the unit office engineers filling job descriptions 54, 55, 56, 58, 60, 61, and 65."

"With respect to office engineers filling job descriptions 59, 64, and 66, the record indicates that none of them performs duties of a technical or engineering nature. The office engineer filling job description 59 combines the duties of a timekeeper, bookkeeper, and librarian; the office engineer filling job description 64 is the liaison officer between the Company and other public utilities; and the office engineer filling job description 66 is in charge of the Company's tax matters. We shall also exclude these office engineers from the unit."

"*Office supervisor*—The Company employs 1 individual in this category (job description 67) and contends that he is a supervisory employee. The record indicates that he supervises the work of approximately 36 employees, makes personnel ratings with respect to them, and that his recommendations affecting their status are given considerable weight by the Company. We shall exclude the office supervisor as a supervisory employee."

"*Research assistants*—The Company contends that 3 of its 11 research assistants (job descriptions 71, 77, and 78) are supervisory employees. The record indicates that each of these 3 employees supervises the work of several subordinates and has authority to or actually does make personnel ratings. Furthermore, their recommendations affecting the status of their subordinates are accorded considerable weight by the Company. We shall exclude the 3 research assistants in job descriptions 71, 77, and 78."

Detailed Determinations of Status

"*Staff Technicians*—The Company contends that 2 of its 3 staff technicians (job descriptions 96 and 98) are supervisory employees, and that the third staff technician (job description 97) is a confidential employee. The staff technician in job description 96 supervises the work of several subordinates, makes personnel ratings, and has authority to make effective recommendations with respect to subordinates. The staff technician in job description 97 is the assistant to the plant superintendent. As such, he has access to all matters pertaining to personnel which are handled by his superior, and is in close and active contact with these matters. The staff technician in job description 98 performs the duties of the assistant plant superintendent in his absence, trains new employees, and makes studies of and recommendations concerning plant operations. We shall exclude all staff technicians."

"*Technical service supervisors*—The Company contends that the 2 technical service supervisors (job descriptions 116 and 117) are supervisory employees. Both supervise the work of several subordinates, make personnel ratings, and have authority to make recommendations affecting the status of their subordinates, which are given weight. We shall exclude them."

"*Cost engineers and assistant cost engineers*—The record is not clear as to whether or not the Association seeks to represent the 4 employees in these two classifications (job descriptions 118, 119, 120, and 121). However, it appears from the record that all are engaged in work of a statistical nature, and we are of the opinion that they are not properly part of a technical and engineering unit. We shall exclude them."

"*Petroleum engineer*—The Company contends that this employee (job description 122) is a supervisory employee. He supervises the work of several subordinates, makes personnel ratings, and his recommendations with respect to his subordinates are accorded considerable weight. We shall exclude the petroleum engineer."

Collective Bargaining Unit Delineated

For the reader who has tried to summarize these exclusions and inclusions, the "box score" submitted in this interesting NLRB decision is quoted in full:

"We find that all technical and engineering employees of the Company engaged at its Central Division, including laboratory assistants; laboratory technicians, draftsmen, construction detailer; designers (except the employee filling job description 12); engineering assistants A filling job descriptions 27, 30, and 31; engineering assistants B; junior engineers; office engineers filling job descriptions 52, 54, 55, 56, 58, 60, 61, and 65; senior draftsmen; research assistants (except those filling job descriptions 71, 77, and 78); technical assistants; air conditioning engineers; industrial gas engineers; service engineers; and estimating engineers, *but excluding* the designer filling job description 12, engineering assistants A filling job descriptions 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, and 32; office engineers filling job descriptions 53, 57, 59, 62, 63, 64, and 66; the office supervisor; research assistants filling job descriptions 71, 77, and 78; staff technicians; technical service supervisors; cost engineers; assistant cost engineers; the petroleum engineer; all other supervisory employees with authority to hire, promote, discharge, discipline, or otherwise effect changes in the status of employees, or effectively recommend such action; and all other employees of the Company, constitute a unit appropriate for the purposes of collective bargaining within the meaning of Section 9 (*b*) of the Act."

It is assumed that those parts of the decision in this case which delineate the employees to be included in an appropriate unit will be made known to such employees. At any rate, the decision called for a secret ballot not later than February 17, 1946, wherein those included in the unit would decide who should represent them. It remains to be seen whether the grouped professional and subprofessional employees which NLRB has assigned to an "appropriate" unit will select CIO or the Association.

The Society an Interested Onlooker

The cost to the Association in connection with fighting this case through was borne entirely by the Association. The American Society of Civil Engineers was not connected in any way with the Association except that some of the members of the Association also are members of ASCE. Some of the CIO group also may be members of ASCE. The activities of the Society in matters of this kind are, in general, in the interest of informing its employee members on the problem of collective bargaining.

President Horner Visits New England Sections

WITH AN INTENSE interest in the activities of the Society at the Local Section level, newly elected President W. W. Horner set off shortly after his inauguration on a series of visits to Local Sections in the New England States. In company with Secretary Wm. N. Carey, Mr. Horner visited in succession the Northeastern Section, at Boston, the Providence Section, in Rhode Island, and the Connecticut Section, at New Haven, on January 21, 22, and 23.

The three-day trip was made with the intent of becoming better acquainted with the interests and needs of the Local Sections and will be followed, in so far as time will permit, by other visits throughout the nation.

Discrimination in Army Proposal Cited

PROPOSED reorganization of the U.S. Army's Medical Department, discriminating against sanitary engineers, has been vigorously opposed by the ASCE Board of Direction. If the plan forwarded to the War Department by medical officers should become effective, the Sanitary Corps would be merged with the Medical Corps and would be directed by medical officers. All high rank in the department would be held by medical officers, with engineer officers definitely restricted to the rank of Major. Further restrictions would be imposed on the age and grade of officers to be commissioned, which would discourage sanitary engineers of demonstrated ability from serving in such capacities. Operation of this scheme would make it impossible to maintain an effective sanitary engineering organization.

In objection to this unsatisfactory design, action was taken, upon recommendation of the Sanitary Engineering Division, at the

January meeting of the Board of Direction in New York. The text of the Board's resolution follows:

WHEREAS the postwar plans for sanitary engineering services for the Medical Department of the Army, as published in the January 1946 issue of the Army Medical Bulletin, provide for the incorporation of Sanitary Engineers into a Medical Service Corps; and

WHEREAS the proposed plan provides for a mixed corps administratively incapable of developing a sound program; and

WHEREAS the requirements for appointment to this corps do not appear to be sufficient to insure the selection of qualified engineers; and

WHEREAS restrictions on the age and grade of officers to be commissioned in the Regular Army will prevent retention of senior sanitary engineer reserve officers with demonstrated ability and leadership in this proposed corps, thus creating a situation wherein all senior officers of the Medical Service Corps would be drawn from non-engineering personnel; and

WHEREAS it is essential that there be retained within the Army a sound and effective sanitary engineering organization; and

WHEREAS it is not deemed possible to maintain such an organization under conditions where pay, initial appointment and rate of promotion are inferior to those proposed for the Medical Corps;

Now, Therefore, Be It Resolved that the Board of Direction of the American Society of Civil Engineers be requested to make strong representations to the Army and the Congress that there be maintained within the Army an effective sanitary engineering organization, and that if such an organization is established within the Medical Department it should be based on the following:

1. A separate technical organization with requirements for appointment of at least seven and preferably eight years of technical education and experience, including a degree from a recognized engineering college;
2. Equality with all other corps of the Medical Department in regard to rank, promotion and opportunity;
3. Waiver of age and rank requirements for integration into the Regular Army of a limited number of senior sanitary engineers in order to provide leadership during the formative period of development in the Regular Army; and

Further, that if a study indicates the advisability of grouping all sanitary engineers into a special division in the Corps of Engineers rather than the Medical Department of the Army, education and experience requirements should be not less than those previously outlined.

Bargaining Under Existing Laws Advised

Report of Society's Committee on Employment Conditions

The Outgoing Board of Direction (1945), at its last session received a report from Chairman A. M. Rawn of the Committee on Employment Conditions. In his report, Mr. Rawn summarized the activities of the Committee since its formation in 1943 and analyzed present trends and future needs. The following is a condensation of the report.

That the recommendations of the Committee on Employment Conditions with respect to collective bargaining, and the Board's actions resulting therefrom have not met with the unqualified approval of the whole Society membership is to put the matter mildly. Probably never before has the Society embarked upon a course of action directed at the solution of so controversial a question or one in which precedent and procedure are in such a state of flux. Fortunately, after committing the Society two years and three months ago, the Board has held pretty closely to the line of procedure proposed at that time, and now has the experience of over two years to guide it in charting the future. It is doubtful that the experience could have been gained in any other way than that employed.

When the Committee on Employment Conditions met in Albuquerque in September 1943, it had before it a report from the Secretary's office which indicated beyond doubt that the inroads upon professional engineer employee ranks by organized union labor were proceeding unopposed in many quarters of the country. The investigation by the Secretary's office had been ordered by the Executive Committee of the Society and the Board and paid for from Society funds. The Committee's line of action had of necessity to be in one of two directions—(*a*) passive resistance and verbal protest against such actions by organized labor plus continued investigation, or (*b*) direct action under the law which would permit the Society to interpose its strength and prestige between the employee member and the non-professional organization which desired to dictate his future.

After an extended period of discussion and a review of past Committee recommendations and Board actions, the Committee unanimously decided to recommend direct action. This was concurred in by the Society's staff and the proposals submitted at Atlanta in October 1943 were formulated.

The Atlanta recommendations not only provided the Society with a course of action, but gave it what was legally implied and stated to be a structure upon which to build. As is now well known, the recommendations formulated by the Board were to be applied at the option of the Local Sections in such a manner as to permit the Society to assist a Section in accomplishing its purpose with as little inconvenience and delay as possible.

What persuaded the Board to accept the recommendations of the Committee? My thought in this connection is that the investigation of conditions which led to the Board's action convinced the Board members that grave injustices to professional engineers would result if the encroachment of union labor into professional engineering ranks remained unchecked; that if such encroachment continued, the professional status of engineers would be seriously impaired, and that the best defense against such encroachment was an aggressive offense.

Before presenting the matter to the Board in October 1943, the Committee members debated the advisability of submitting the entire question and plan to the membership as a whole. They decided against recommending such a course of action because what was suggested to the Board did not demand that members comply with the recommendations, but rather that they follow the general course of action, recommended by the Board, at the option of each Local Section. It appeared to the Committee members that a referendum was actually indicated wherever and whenever a Local Section decided to adopt and put into effect the procedure which the Board authorized and advised. All of these factors were perfectly apparent to the Board itself and are undoubtedly the reason why the matter was not referred to the membership as a whole for concurrence or objection.

You are now fully aware of the fairness of the Board's proposal and the manner in which its acceptance or rejection has expressed the need for such a plan and procedure in the several sections of the country. Reports of my Committee, particularly that of July 1945, cover the intervening months from October 1943, and any who have taken the time to read CIVIL ENGINEERING or follow the Board and staff action are aware of the status of collective bargaining as an offensive and defensive measure for our professional employee members as of this date. I will not recount here all that has occurred. The Society has learned much about its legal rights and the limitations of its staff, and the Board appears to have modified its thinking accordingly.

Commencing in January 1944 certain members of the Board have made proposals which they believed—and probably still believe—will relieve the pressure of collective bargaining and union labor upon the professional engineering employee. During my experience on the Board and—I am informed, during the past year—every proposal so made has been supported by the Board and, to a considerable degree, financed. Most such proposals, other than that which the Board adopted in 1943, are aimed at amending national law so that professional employees cannot be forced into heterogeneous collective bargaining groups, and in some instances it appears likely that the proposed revisions to laws might accomplish such a job.

I leave it to the judgment of the Board to determine how much

benefit the employee-engineer in ASCE or his counterpart in the other Founder Societies, would have gotten during the past two years and three months had the Committee on Employment Conditions and the Board been satisfied to let these fruitless efforts to amend one of the strongest and most enthusiastically supported national laws stand as its sole contribution to the perplexing problem of collective bargaining as it applies to the employee-engineer. I do not offer this in defense of the Board's action. I am as convinced as anyone that only by successfully amending the National Labor Laws so as to permit true professionalism to flourish without restraint and regimentation, can the professional status of a professional employee be assured and allowed to develop. I ask your judgment in the matter more to indicate whether you feel as I do, that far greater benefits have accrued to the Society, its professional members and its management because of the direct course which the Board adopted, than from all of the planning for, and discussion of, other courses of action that have been vainly proposed.

Looking over the years 1944 and 1945 one cannot help but be impressed by what appeared to be great potentialities in the formation of the Engineers Joint Council of the Founder Societies and its apparently vigorous pursuit of basic data designed to indicate clearly the engineer's professional status and his need for assistance in the economic phases of his career. It was destined also to demonstrate what the joint action of more than 100,000 professional engineers might accomplish in attaining remedial legislation designed to assist the professional employee in his professional career. Those interested in such matters as collective bargaining and its effect upon professional employees looked with eagerness to the issuance by the Joint Council of a complete down-to-the-minute treatise on collective bargaining which would indicate, with all possible clarity, a course of action by professional groups designed to exclude them from trade and labor unions.

ENGINEERS JOINT COUNCIL MANUAL

In my Committee's report of July 5, 1945, is a statement that the Committee had left, and preferred to leave, recommendations related to collective bargaining in Section groups in the status quo until such time as the Engineers Joint Council of Founder Societies could complete its statistical work and compile its manual, believing that the work would be accomplished by the end of 1945. This recommendation was made in recognition of the energy and ability of the Society's principal representatives on the Committee; President Malcolm Pirnie and William N. Carey. It was believed by the Committee that if any group could and would produce results, one to which these two gentlemen loaned their energies, would so do.

Fortunately for employee-engineers in many parts of the country, the Board did not alter its 1943 recommendations, other than to modify them in conformance with a better comprehension of the law. I do not know the current status of the work of the Engineers Joint Council, but I again leave it to the judgment of the Board to determine what comfort might have been gained by the employee-engineers from accomplishments of the Joint Council to date. I make this suggestion without criticism but rather in the light and knowledge of the difficulties which attend attempts at prompt action in large and loosely joined groups.

It has been propounded by many that to engage in advancing the economic welfare of the employee-engineer is to altogether too greatly subordinate the main objectives of a society such as ours. Those who advance this thesis are perhaps not aware of the fact that the pattern for this was set years ago and the Society has consistently interested itself in the welfare of the engineer, particularly in private practice, and has formulated codes of ethics and practice designed almost wholly to protect him from inroads by engineers in public service, on teaching staffs and otherwise. There has never been any quarrel between members over this issue. It has always been an accepted fact to employee-engineers that the private practicioneer should be protected in his vocation.

It has been stated by Society members that there should be a more conservative Committee on Employment Conditions than as now constituted. What means this word conservative? Is it implied that the present committee is radical in attempting to adapt existing law to protecting Society members from inclusion in labor unions which will dictate their wages, hours and working conditions and formulate their future professional objectives? Is it implied that those who would seek to change such laws are conservative? My thought is quite the opposite. Rather than to term members of the Committee conservative and radical it might be well to imply that they are respectively those who would correct labor abuses in professional circles by changing existing law and those who would apply existing labor laws to their own correction.

COMMITTEE CONVICTIONS

The Committee majority has been consistent in its attitude and recommendations. It believes:

(*a*) that professionalism in engineering is threatened by labor unions;
(*b*) that the majority of professional engineering employees are willing to sacrifice whatever immediate benefits may accrue from labor union membership in order to retain their professional status;
(*c*) that whatever advantages there are in collective bargaining for the professional engineer may best be gained through bargaining at the professional level;
(*d*) that membership in a labor union places the professional engineer in an embarrassing and ambiguous position with both labor and management.

I believe I speak for the majority of the Committee as presently constituted in urging the Board to continue its interest, both financial and advisory, in the sponsoring of collective bargaining groups wherever local conditions indicate their advisability. I think I bespeak the Committee members and literally thousands of Society members in stating that the past two years and three months of experience with this perplexing problem has been a good and healthful interval in the Society's life and that ASCE now knows more about the question and its solution than any other professional group. On behalf of the Committee I urge that the knowledge gained at considerable expense and no small effort and embarrassment be put to useful purpose, and that you do not jettison what has been learned, in favor of promises of what the future may hold.

Yours very truly,
A. M. RAWN, *Chairman, Committee on Employment Conditions, ASCE*

January 7, 1946

Veterans' Guide Circulated

A GUIDE for veterans interested in the construction industry is being circulated by the American Society of Civil Engineers. The booklet, entitled *Opportunity Unlimited*, has been prepared to assist men in choosing a career or looking for a job, or employers who have opportunities for such men. The format and information presented are especially helpful to local organizations and individuals entrusted with the counseling of returning veterans. The information is so presented that it will be helpful not only to veterans but to all others who may be interested in the construction industry.

"If You Are Interested in a Trade" is the title of one chapter, which carries information about specific jobs, training needed, wages and hours, prospective employers, and related facts. Similar sections of the booklet are devoted to opportunities in private business and in the professions. Prospects for the future of the construction industry in its relation to the individual engaged in it are candidly presented.

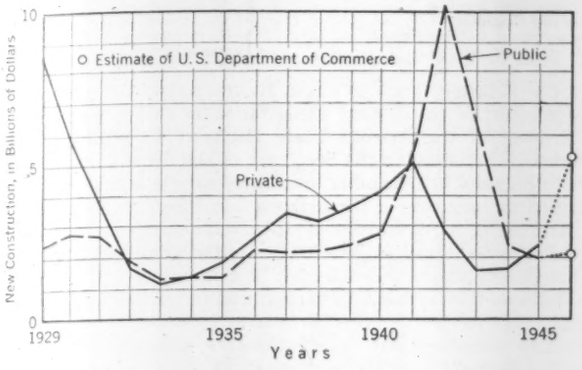
COOPERATING ORGANIZATIONS

Preparation of the guide was financed by eleven professional and trade organizations, and copies are being distributed through the local groups affiliated with these organizations. The ASCE has placed copies in the hands of Local Section officers, who will gladly assist any interested person in the use of the guide.

Other local groups engaged in advising veterans are encouraged to make use of the booklet and may obtain copies from their headquarters, if they are associated with one of the cooperating organizations, or from the secretary of the publication's committee, E. L. Chandler, Room 703, 1026—17th Street, N.W., Washington 6, D.C. A charge of 10 cents a copy is made. Members of the ASCE may obtain copies from Society Headquarters as long as the limited supply for such distribution lasts.

Will Construction Costs Stifle Construction?

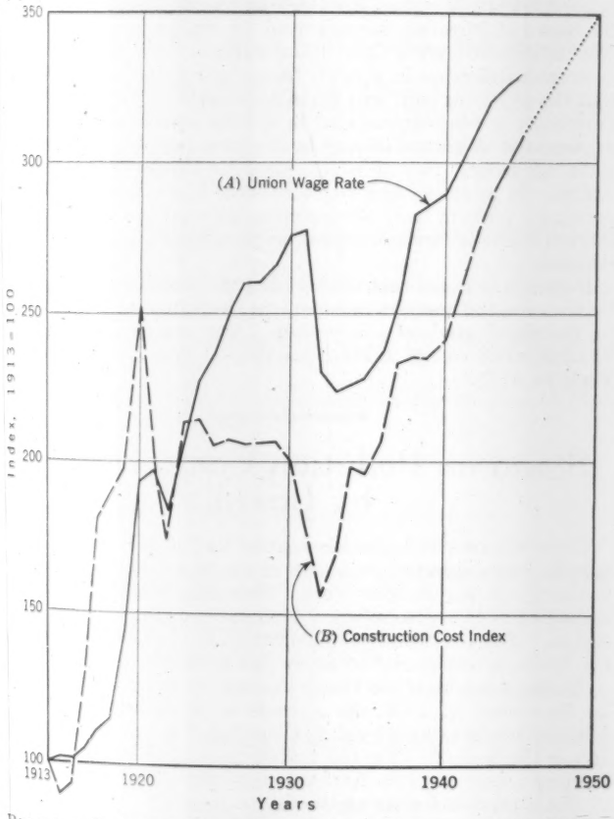
ADDRESSING himself to a prediction of the trends of future construction costs, Louis R. Howson at the January meeting of the Sanitary Engineering Division expressed his grave misgivings and his expectation of adverse effects on engineering undertakings. In order to evaluate the present prospects, Mr. Howson considered



ESTIMATE OF U. S. DEPARTMENT OF COMMERCE ON PUBLIC VERSUS PRIVATE EXPENDITURES FOR NEW CONSTRUCTION, 1929–1945, FROM HOWSON PAPER

a number of variables extending over many decades, including the investment in new construction activity year by year, with adjustment for the variation in unit costs; the relationships between public and private construction; and particularly the effect of wars in raising price levels.

With this as a background, Mr. Howson attempted to predict the trend in 1950. From all this he drew a number of cogent conclusions: (1) The labor picture and the government relation to it create uncertainty and reluctance on the part of contractors.



RELATION BETWEEN WAGE RATES AND CONSTRUCTION COST—GRAPH FROM HOWSON PAPER, TO APPEAR IN MARCH "PROCEEDINGS"

Dotted Extension Shows Projection of Cost Trend to 1950

Hence construction might well await some clarification, and particularly wage stabilization. (2) The scale of construction costs by 1950 might reasonably reach a level 50% greater than 1940, or even higher. (3) Even with the wage situation stabilized, costs will probably continue to rise, with the result that much construction will be retarded or even abandoned for this reason. (4) Another deterrent is caused by waiting for a policy on federal aid for public works, public officials being particularly vulnerable if they fail to take proper advantage of government subsidies. (5) Much sanitation work, of which two billion dollars worth is in development, will be delayed indefinitely because prices have already got far beyond those originally anticipated as the basis for planning.

The complete article by Mr. Howson, with graphical data and his running comments, constitutes a particularly timely treatment of this important national problem. It will appear in the forthcoming March PROCEEDINGS, where it will be open for general discussion. All members will be interested, whether from the standpoint of its valuable information or from that of direct personal application. The study of these cost trends through past years only emphasizes their significance for engineering construction in the future.

ECPD Resolution Urges Deferments for Engineering Students

ON JANUARY 18, the Engineers' Council for Professional Development sent the following resolution to John W. Snyder, Director of War Mobilization and Reconversion, in Washington, D.C.:

WHEREAS national security and public welfare are dependent upon and vitally affected by the quality of scientific, engineering and technological research, both fundamental and applied;

WHEREAS fundamental and applied research are entirely dependent upon an ample supply of trained and experienced manpower;

WHEREAS the ranks of scientists and engineers have been seriously depleted since 1941 by the requirements of military service;

WHEREAS the normal flow of students into the colleges and the engineering, technical, and graduate schools has almost completely ceased during the period from 1941 to 1945;

WHEREAS the alarming deficit in highly trained technical personnel will be further increased if Selective Service is continued without full recognition of the fact that technical personnel is as vital to national security and welfare as military personnel;

WHEREAS the acute shortage of scientific and engineering personnel in the colleges, in government agencies and in industry must be immediately alleviated in the national interest;

WHEREAS full cooperation of the legislative and executive branches of the Federal Government is essential, not only in the implementation of this emergency program which is designed to correct the deficit (now estimated at approximately 150,000) of scientific and technical students, but also in assuring a future supply of trained manpower, adequate in numbers and in skill to meet the involved problems of national reconversion, progress, welfare and security.

Therefore be it resolved:

(1) that deferment procedures for those in scientific and engineering training at graduate and undergraduate levels and also for those in scientific and engineering occupations in industry and in professional pursuits, including teaching, be reestablished.

(2) that those whose engineering education was interrupted by entrance into the Service be given the option of discharge to civilian state, to complete their professional engineering training.

(3) that every effort be made to release from the Service those men who have completed their professional engineering training in order that they may be immediately available to lessen the critical shortage existing in the engineering profession.

(4) that to enable men to complete their engineering training deferment be granted to those students who have not yet finished preparatory school but have been accepted by an accredited engineering college.

Therefore be it further resolved that the imperative and immediate need of replenishing scientific and engineering manpower be called to the attention of the President and the Congress.

Be it further resolved that the President be asked to take prompt steps through the Selective Service procedure to insure a flow of

scientific and engineering personnel through the colleges and the engineering, technical and graduate schools adequate to national security and the public welfare.

In connection with this resolution, it is of considerable interest to quote from the reply sent by S. J. Donald Kingsley, Director for Manpower, Office of War Mobilization and Reconversion, to the Chairman of the E.C.P.D., Everett S. Lee, on January 25:

"At the request of this office, the Selective Service System has agreed to give special consideration to the deferment of scientists and engineers . . . .

"Selective release of highly qualified personnel essential for reconversion activities is now under discussion with the War and Navy Departments."

Engineer's Wife Holds Long-Time Meeting Attendance Record

FAITHFUL attendance by members at Society meetings is taken as a matter of course, while similar interest on the part of their wives is apt to be overlooked. Among those at the recent Annual Meeting was Mrs. Frank E. Winsor, attending her thirty-seventh yearly meeting.

Her record was established over a period of 41 years, starting in 1906. At that time, and for many years after, Mr. Winsor was in responsible charge of work for the New York Board of Water Supply. Subsequently he continued similar activities in Providence and Boston, and served terms as a Director and Vice-President of the Society. Even under these favorable conditions, the regularity of Mrs. Winsor's attendance, extending through the period following his death on January 30, 1939, is worthy of note. Of her four absences, two occurred during the recent war years.

Possibly other ladies can boast of an even better record. If so, it would be interesting to know. Notable records on the part of the men include that of T. Kennard Thomson, who has attended all but two Annual Meetings in the 54 years since 1892, and that of the late H. C. Keith, who missed only four Annual Meetings in 55 years, as noted in the February 1944 issue of CIVIL ENGINEERING, page 82.

Glenn L. Parker, Former Society Director Dies

THE MANY friends of Glenn L. Parker will be shocked to learn of his death in Washington, D.C., on February 12, 1946, at the age of sixty-one. His connection with the Society goes back many years—to 1911 when he became an Associate Member. He was admitted to the Member grade in 1921, and served on the Board of Direction as Director from District 12 for the two years 1939–1940, having been selected by the Board to fill the unexpired term of Ross K. Tiffany, who died in office. Mr. Parker was a native Westerner. In fact, his birthplace was in Butte, Mont., in the Society District he represented.

GLENN L. PARKER, 1884–1946

Following graduation with a B.S. in civil engineering from the University of Kansas, and postgraduate work there, Mr. Parker spent a short time on railroad work, then a year with the U.S. Coast and Geodetic Survey. His life work really began in 1909, when he went with the U.S. Geological Survey, which organization claimed his services up to the time of his death.

For many years he was district engineer for the Survey at Tacoma, Wash. Much of his work after 1919 had to do with water-supply, storage, and power analyses for the Columbia Basin irrigation and power project. In 1939 he was made Chief Hydraulic Engineer, Water Resources Branch, with headquarters in Washington, D.C.

Arizona Highway Salaries Raised

SALARY RATES for engineering employees of the Arizona State Highway Department have been raised substantially, as of January 1, 1946, by action of the Arizona State Highway Commission, following ASCE participation in the studies. The new rates are:

POSITION	SALARY PER MONTH
State Engineer	$600, increase of $100 per month
Deputy State Engineer	$550, increase of $100 per month
Department heads	$450, increase of $ 50 per month
District Engineers	$450, increase of $ 50 per month
Department assistant heads	$375, increase of $ 25 per month
All other employees	Increase of $15 per month

In the February issue of CIVIL ENGINEERING there appeared a brief account of the Society's assistance on this project, given at the request of the Arizona State Highway Commission. Allen Richmond, Assistant to the Secretary of the Society, made a short visit to Phoenix in December, evaluated salary data that had been collected by members of the Arizona Local Section, assisted in the preparation of a recommended up-to-date salary curve, and presented it to Secretary Eugene Eagles of the Highway Commission. Although the above increases are not identical with the recommendations, the factual information and recommended curve were of assistance to the Commission in arriving at its decision.

Society members will unquestionably commend this prompt remedial action to authorize more equitable salary rates for Arizona engineering employees, and particularly for the improvement of rates in the higher grades. Such action is a well-deserved recognition of the importance of the positions whose incumbents are responsible for all the work of the department.

Transfer to Member Grade Simplified

TRANSFER from the grade of Associate Member to that of Member in the American Society of Civil Engineers has been facilitated by the approval of a new shortened application form. With evidence that the effort involved in filling out the old form dissuaded many Associate Members from seeking transfer to the higher grade, the Board of Direction has approved the change, as reported in the November 1945 issue of CIVIL ENGINEERING.

Notable difference in the new forms, which are now available, is that the applicant need only bring his experience record up to date. Previously it was required that he list the entire history of his engagements. A second change in the form requires listing of only three references, two of which must be Corporate Members of ASCE. In addition, as a further incentive to those who take no particular pride in their photographs (a forced concession that not all civil engineers are handsome), no photograph of the applicant is required.

It should be noted that while easing the procedure of application for transfer, the new arrangement in no way alters the requirements for the higher grade of membership. The new forms are available on application to ASCE Headquarters, 33 West 39th Street, New York 18, N.Y.

Stand on Pollution Control Upheld by Board

COORDINATION of pollution control by the U.S. Public Health Service was supported by action of the Board of Direction at its January meeting in New York. Provisions for such control are embodied in House Resolution 4040 under consideration in Washington. The previous recommendation of the Sanitary Engineering Division was strengthened by this action.

During a session of the House Committee on Rivers and Harbors on November 13, 1945, the attitude of the Sanitary Engineering Division was presented by E. L. Chandler, Washington Representative of the Society. The full text of his testimony appeared in the February issue of CIVIL ENGINEERING, page 81.

The Board has thus supported in principle the provisions of H.R. 4070 and disapproved two other bills, H.R. 519 and H.R. 587, which are also pending in the House. The primary difference in the bills is the conflicting concept of the extent of federal authority to be exerted in the regulation of matters pertaining to sanita-

tion. While H.R. 4070 would coordinate, present regulating agencies, both local and federal, through the establishment of a Water Pollution Control Advisory Board, the other bills would create new federal agencies to administer the complete program.

Provisions of H.R. 4070, which would extend federal grants for construction, were not approved by the Sanitary Engineering Division. This view was concurred in by the Board's action.

Montana Local Section Organized

A NEW and vigorous unit of the Society has been set in motion with the organization of the Montana Section. Membership of the new Section comes from the entire state of Montana and has been drawn from remote areas of the Northwestern and Spokane Sections. The meeting for organization, election of officers, and adoption of a constitution and bylaws, was held in Helena on January 18.

The assigned membership in the new Section totals fifty-five. These men, prior to the formation of the Montana Section, were faced with the necessity of traveling some 400 to 800 miles to the nearest Local Section meetings. This was obviously impossible in most cases. As newly elected President of the Section, Charles S. Heidel pointed out, "The monthly meetings of the Local Section will establish an acquaintance and friendly relationship between an increasing number of engineers throughout the state, thereby developing a solidarity of spirit and objectives not now enjoyed." President Heidel went on to point out the advantages of an active local group in capitalizing the opportunities and advantages of affiliation with ASCE.

Nearly six years have elapsed since the formation of any other new Local Section. Most recent was the Tri-City Section, which was accepted in April 1940. At the other end of the time scale is the San Francisco Section, the first organized, which was started in 1905.

Other officers of the new Section are David M. MacAlpine, 1st Vice-President, George F. Sahinen, 2nd Vice-President, and R. H. Willcomb, Secretary-Treasurer. The Section will be included in Zone IV, District 12, of Society structure.

News of Local Sections

Scheduled Meetings

CENTRAL OHIO SECTION—Dinner meeting at the Oxley Hall Tea Room on March 21, at 6 p.m.

CINCINNATI SECTION—Inspection of the Ohio River Division Laboratories, Corps of Engineers, on March 12 at 8 p.m.

COLORADO SECTION—Dinner meeting at the Oxford Hotel on March 11, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Engineers' Club on March 18, at 12:15 p.m.

DISTRICT OF COLUMBIA SECTION—Evening meeting at the Cosmos Club on March 19 at 8 p.m.

FLORIDA SECTION—Dinner meeting at the Seminole Hotel on March 7, at 7 p.m.

GEORGIA SECTION—Luncheon meeting in Davison's Tea Room on March 1, at 12:30 p.m.

INTERMOUNTAIN SECTION—Dinner meeting at the Beau Brummel Restaurant on March 15, at 6:30 p.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on March 13, at 6:30 p.m.

LOUISIANA SECTION—Smoker at the St. Charles Hotel on March 11, at 8 p.m.

MARYLAND SECTION—Dinner meeting at the Engineers' Club on March 20. Cocktails at 6 p.m.; dinner at 7 p.m.; meeting at 8 p.m.

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building on March 20, at 8 p.m.

MIAMI SECTION—Dinner meeting at the El Commodoro Hotel on March 7, at 7 p.m.

NEBRASKA SECTION—Dinner meeting on March 4, at 6:45 p.m.

NEW MEXICO SECTION—Smoker at the El Fidel Hotel on March 9, at 5:30 p.m.

NORTHWESTERN SECTION—Dinner meeting at the Minnesota Union on March 4, at 6:30 p.m.

OREGON SECTION—Technical meeting in the Public Service Auditorium on March 21, at 8 p. m.

PHILADELPHIA SECTION—Technical meeting at the Engineers Club on March 12, at 7:30 p.m.; preceded by a good-fellowship dinner at 6 p.m.

ST. LOUIS SECTION—Luncheon meeting at the York Hotel on March 25, at 12:15 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12 m.

SAN DIEGO SECTION—Dinner meeting at the U.S. Grant Hotel on March 28, at 6:30 p.m.

SAN FRANCISCO SECTION—Dinner meeting of the Junior Forum at the Engineers' Club on March 28, at 5:45 p.m.

TENNESSEE VALLEY SECTION—Dinner meeting of the Knoxville Sub-Section at the S & W Restaurant on March 13, at 6 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch of the Adolphus Hotel on April 1, at 12:15 p.m.

Recent Activities

CENTRAL ILLINOIS SECTION

A joint meeting of the Section and the Champaign County Chapter of the Illinois Society of Engineers took place in Urbana on January 10. The technical program for the occasion consisted of a talk by W. C. Huntington, head of the department of civil engineering at the University of Illinois and chairman of the university's building program committee. Professor Huntington outlined the university's postwar building program, emphasizing the fact that studies will be required to determine just what is needed.

CENTRAL OHIO SECTION

On January 17 members of the Central Ohio Section heard Ralph W. Powell, associate professor of mechanics at Ohio State University. Professor Powell developed his topic, "Lecture and Demonstration on Hydraulic Models," by discussion and exhibition of working laboratory-size models and projected pictures of large-size equipment.

CINCINNATI SECTION

A new roof is being put on the dome of the Cincinnati Union Terminal, and this interesting project was described by J. C. Bussey at the January meeting of the Section. Mr. Bussey, who is maintenance engineer for the Cincinnati Union Terminal Company, showed by means of blueprints and slides the nature and extent of the failure of the original tile roof and the design and construction features of the new aluminum roof now being erected. Mr. Bussey pointed out that the dome is one of the largest in the world, having a diameter of 180 ft, whereas the dome of St. Peter's in Rome has a diameter of 137½ ft, and that of St. Paul's in London of 109 ft. The original tile roof, which weighed over a million pounds, is being replaced by aluminum sheeting that will weigh less than 60,000 lb.

CLEVELAND SECTION

At the annual meeting of the Cleveland Section, which was held on January 10, the following new officers were elected for the coming year: James C. F. Shafer, president; Arthur H. Stark, vice-president; and Alfred D. Yanda, secretary-treasurer. A talk on "Limitations in the Accuracy of Flood Studies" comprised the technical program for the occasion. This was given by William P. Creager, Buffalo consultant, who had compiled interesting facts and figures on his subject from all over the world. He emphasized the inherent inaccuracy of flood predictions in the past, and stated that three billion dollars have been expended on flood control in the United States, but that there have been many costly and disastrous floods.

COLORADO SECTION

An illustrated talk on "China's Interior" was presented by Robert L. Bittle at the meeting held on January 14. Various business matters were discussed during the evening, and the Section went on record as favoring the Magnusson Bill. Another feature of the occasion was the presentation of certificates of life membership to four members—A. N. Miller, F. W. Whiteside, M. C. Hinderlider, and B. G. Coy.

CONNECTICUT SECTION

Guests of honor and speakers at the annual meeting of the Section—held in New Haven on January 23—were W. W. Horner, newly elected President of the Society, and Col. W. N. Carey, Secretary and Executive Officer. In their talks both discussed current Society activities. During the business session various committee reports were heard, and certificates of life membership were presented to Percy Remington Leete and Leon Friend Peck. The annual election of officers, also held at this time, resulted in the selection of William S. Wise as president; Philip G. Laurson, as vice-president; and Harold L. Blakeslee, as secretary-treasurer.

DAYTON SECTION

Society Director Frank C. Tolles addressed the December 12 meeting of the Dayton Section, commenting on Society affairs and plans for the future. During the evening officers for 1946 were elected as follows: Ralph L. Woolpert, president; George T. Neuffer, first vice-president; William E. Macy, second vice-president; and Charles Black, secretary-treasurer. The January meeting took the form of a joint session with the Engineers' Club of Dayton. The joint assemblage enjoyed a talk by Lt. Col. M. W. Tatlock, who outlined his activities in the European Theater of War. Colonel Tatlock was public works and utilities officer with military government units engaged in restoring water and sewerage facilities that had been destroyed by the war. Three other returned veterans also attended the meeting and received a warm welcome. These were Robert Printz, now with Charles H. Shook, Inc.; Richard K. Smith, in the Dayton City Engineer's Office; and Robert A. Voeler, in the civil engineering department at Antioch College.

DISTRICT OF COLUMBIA

The January meeting of the District of Columbia Section featured a resumption of the annual dinner after a lapse of three years due to the war. In the absence of Colonel Carey, Allen Wagner represented Society Headquarters and spoke briefly. Following the presentation of the guests of honor, Society Director Gail A. Hathaway presented the Norman Medal to Merrill Bernard for his paper on "Primary Role of Meteorology in Flood Flow Estimating." It had been planned to bestow the medal at the Annual Meeting in New York, but Mr. Bernard was delayed in his return from a trip to Russia. The high point of the evening was a talk on the atomic bomb project by Maj. Gen. Leslie R. Groves, Assistant Chief of Engineers, U.S. Army, and director of the project. General Groves dealt chiefly with the difficulties of completing necessary construction for the project and getting production under way, citing a number of statistics to illustrate the vastness of the undertaking. He also paid a tribute to the workers on the project, saying that only the closest team work could achieve the speed required for completion on time.

PRESENTATION OF NORMAN MEDAL TO MERRILL BERNARD AT DISTRICT OF COLUMBIA SECTION DINNER

Left to Right: Society Director Hathaway, Section President Weaver, and Medallist Bernard

ILLINOIS SECTION

The feature of the annual meeting—held in Chicago on December 17—was the presentation of certificates of life membership to ten members. The Hon. E. J. Kelly, veteran Mayor of Chicago, was one of the recipients and responded for the group. The annual election of officers resulted as follows: I. F. Stern, president; L. R. Howson and G. S. Salter, vice-presidents (the latter for two years); and A. L. R. Sanders, secretary for two years. On January 29, the Section met jointly with the Western Society of Engineers to hear Harold W. Richardson, executive editor of *Construction Methods*. Mr. Richardson's talk included a first-hand report on the damage done to the city of Nagasaki by the atomic bomb.

INTERMOUNTAIN SECTION

On December 14, Comdr. H. M. Sylvester, Civil Engineer Corps, U.S. Navy, addressed the Section in Salt Lake City on the work of the Navy Construction Corps, supplementing his talk with a 47-minute film. During the business meeting Robert G. Harding was elected president for the coming year; Ralf Wooley, first vice-president; and E. U. Moser, second vice-president. A joint session with the local group of the American Society of Mechanical Engineers comprised the January meeting, which was held at the University of Utah on the 15th. The feature of the occasion was a talk on the subject of "Jet Propulsion and Rockets," given by Dr. Lionel S. Marks and much enjoyed by all present.

ITHACA SECTION

"The Doings of the Navy Civil Engineer Corps" were discussed by L. L. Huttleston at the Section's January meeting. Mr. Huttleston, who is vice-president of the Section, has just returned from service as a lieutenant commander in the Seabees. Using his own battalion as an illustration, he outlined the organization of the unit and described the problems encountered in building a "black oil" fueling station at Sitka.

KENTUCKY SECTION

An afternoon inspection trip to the Jeffersonville (Ind.) Flood Protection Works preceded the annual dinner meeting of the Kentucky Section, held in Louisville on December 14. S. M. Bailey, chief engineer of the Louisville District of the U.S. Engineer Department, conducted the group about the project and explained the various features of construction. At the dinner meeting that followed Society Director Frank C. Tolles spoke on Society affairs, and Lt. Lee Allen Estes, of the Kentucky Highway Patrol, then presented an illustrated lecture, entitled "I'll Betcha." Details of the business meeting included the presentation of a certificate of life membership to Edward N. Todd, of Richmond, and the annual election of officers. Results of the election were as follows A. L. Chambers, president; S. M. Bailey, vice-president; C. R. Sansbury, secretary-treasurer; and R. W. Pride, corresponding secretary. Harry W. Schacter, president of the Committee for Kentucky, was guest speaker at the luncheon meeting held in Lexington on January 25. Mr. Schacter discussed the aims and accomplishments of the Committee, which hopes ultimately to solve some of the major problems confronting the state and improve its status in general. Members of the Kentucky Society of Professional Engineers were guests of the Section for the occasion.

LOS ANGELES SECTION

The Los Angeles Section reports that the January meeting was unusually successful from the point of view of both attendance and interest. The first speaker—Lloyd Aldrich, city engineer of Los Angeles—presented a paper on "Parkway Planning in Metropolitan Areas," with particular reference to the Los Angeles area. Predicting increased ownership of cars and increased use of buses

and trucks throughout the metropolitan area, Mr. Aldrich presented numerous reasons for the development of parkways and outlined the basis of design which will be followed in the Los Angeles area. Then Mr. Wilson, engineer for the city, presented a great deal of timely information on the subject of the proposed parkway outlining the problems and difficulties encountered in the design and explaining the work that has been done in his office.

LOUISIANA SECTION

The principal speaker at the January 12 meeting of the Louisiana Section was Gen. P. H. Timothy, who gave an interesting illustrated address, entitled "Crossing the Rhine—Largest Operation of Its Kind in Military History." He was followed by Walter Scales, Southern division manager for the National Lumber Manufacturers' Association, who spoke informally on the possibilities and effects of the Hatch-Hall-Burton Bill, now before Congress. The session was part of the annual meeting of the Louisiana Engineering Society.

MARYLAND SECTION

A symposium on construction costs comprised the technical program at the January 23 meeting of the Section. The first speaker was Oscar Coblentz, of the McLean Contracting Company and former president of the Associated General Contractors of America. One factor tending to increase present-day construction costs, Mr. Coblentz pointed out, is the lack of a ready flow of materials, which results in loss of time. It was stated that engineers should specify alternate materials, which might be more readily obtainable and result in a steady flow to the job. The next speaker —William B. Spencer, of the Consolidated Engineering Company, of Baltimore—spoke from the viewpoint of the general building contractor engaged in the construction of large buildings of all kinds. He expects a future increase in prices for both labor and materials, and suggested that the designer use established standards to reduce construction costs. Harold J. Dudley, general contractor of Baltimore, then presented the viewpoint of the small contractor. It is his belief that OPA ceilings should be maintained, as their removal would result in an "auction" in which the large contractors would probably get all the construction materials. The point of view of an economist in construction work constituted the concluding talk. This was given by J. D. Tuller, of the Tuller Construction Company, Red Bank, N. J.

NORTHWESTERN SECTION

One of the features of the annual meeting of the Section—held at the University of Minnesota on December 3—was the presentation of a certificate of life membership to Adolph Meyer. Next on the program was the election of officers, resulting as follows: William B. Irwin, president; Edwin M. Grime, first vice-president; Harry L. Wilson, second vice-president; and Frank S. Altman, secretary-treasurer. The scheduled speakers were J. L. Morrill, president of the University of Minnesota, who discussed problems of education, commenting especially on the consideration that is currently being given to extending the time for engineering education; and Gordon Volkenant, new products coordinator for the Minneapolis-Honeywell Regulator Company, of Minneapolis, who gave a talk and demonstration on "Electronics, the Magic of War and Peace." Numerous business matters were discussed at the February 4 meeting. Guest of honor and speaker for the occasion was John L. Mills, recently from the headquarters of the Third Military Railway Service at Teheran. Mr. Mills spoke on railway operation and facilities in Iran, supplementing his remarks with interesting colored movies of the country.

OKLAHOMA SECTION

The annual meeting of the Oklahoma Section—held in Oklahoma City on December 8—consisted of an afternoon business session and a dinner and technical meeting in the evening. At the first of these sessions, officers for 1946 were elected as follows: Leo D. Boswell, president; Hubert L. Hendrix, first vice-president; Leo L. Laine, second vice-president; and J. E. Lothers, secretary-treasurer. Also, during this session J. Frank Relf, district engineer for the Soil Conservation Service, presented a paper, entitled "Some Observations on Drainage Work in Oklahoma." At the evening dinner meeting H. F. Thomson, Society Director from District 14, gave a talk, entitled "American Society Affairs." An interesting open discussion on the question of whether or not to continue the two grades of corporate membership followed his remarks. Then Prof. Doel Reed, of the art department at the Agricultural and Mechanical College of Oklahoma, read a paper on the drawings and engineering works of Leonardo da Vinci. On January 12, the Section held a brief business session, recessing later to participate in a joint meeting of the Oklahoma Society of Professional Engineers and the Oklahoma chapter of the American Institute of Architects.

PROVIDENCE SECTION

Guests at the January 22 dinner meeting of the Providence Section included President Horner; Secretary Carey; Capt. R. E. Bassler, of the Civil Engineer Corps of the U.S. Navy; A. Harkness, president of the Rhode Island Chapter of the American Institute of Architects; and Thomas H. Coe, new life member of the Society. Both Colonel Carey and Mr. Horner spoke briefly, the latter discussing "The Engineer's Place in the Postwar World." Mr. Horner then presented a certificate of life membership to Mr. Coe. The feature of the occasion was a talk on "France—Its Foundation, Fall, and Future," which was given by J. D. Townsend, who spent 28 years in France, fleeing from Paris two days before the Germans entered the city.

ROCHESTER SECTION

The following new officers were elected at the January meeting of the Rochester Section: Philip F. Stephens, president; Cecil Aronson, first vice-president; Henry G. Lehrbach, second vice-president; and Robert R. Sheridan, secretary-treasurer. The speaker of the evening was Perfecto A. Covas, who is in the engineering and maintenance department of the Eastman Kodak Company.

SACRAMENTO SECTION

During January the Sacramento Section enjoyed two meetings, at which the measurement of water was discussed. The first consisted of a moving picture, prepared by the U.S. Bureau of Reclamation; and the second was an actual demonstration of the use of stream-gaging equipment. The latter program was arranged by Irvin Ingerson, of the California Division of Water Resources, and Franklin Craig, of the U.S. Geological Survey. "Snow Removal from Highways in the Sierra Nevada" was the subject of another meeting, at which Nelson Bangert and Clyde J. Gorman were the speakers. At the annual meeting, on the 8th, officers for 1946 were elected as follows: Gerald H. Jones, president; Robert L. Wing first vice-president; Arthur J. McNeil, second vice-president; and Edwin F. Sullivan, secretary. These new officers were installed at the annual dinner and dance on January 12, which was attended by over 130 members and guests.

SOUTH CAROLINA SECTION

The annual winter meeting of the South Carolina Section—held in Columbia on January 23—took the form of a joint session with the South Carolina Society of Engineers and consisted of a technical session, business meeting, and banquet. The following speakers appeared on the technical program: William H. Mills, testing engineer for the South Carolina Highway Department; W. J. Connelly, manager of consumer relations for the Bakelite Corporation, of New York; Albert A. Daniels, assistant manager of the educational section, Electromotive Division, General Motors Corporation, La Grange, Ill.; and James H. Hammond, chairman of the board of directors of the South Carolina Public Service Authority. During the business meeting J. Hearst Coleman, of Greenwood, S.C., was elected president for 1946.

TACOMA SECTION

On December 18 members of the Tacoma Section gathered at the Fort Lewis Inn between Tacoma and Olympia for a dinner meeting. The annual election of officers, held at this time, resulted in the selection of Fred M. Veatch, as president; Charles E. Andrew, as vice-president; and Charles H. Strong, as secretary-treasurer. These officers were installed at the annual meeting on January 5, which was open to the ladies of the Section. At the latter meeting Mr. Veatch led the group in community singing between the dinner courses, and later gave a short talk outlining the activities of the Society and describing its aims and purposes. Another feature of the occasion was the presentation of a certificate of life membership to Wilbur C. Raleigh. Social dancing concluded the program.

ITEMS OF INTEREST

About Engineers and Engineering

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. ASCE

FOR ONCE the Professor didn't start the argument—or end it either. At one end of the long dinner table, speculation on when one could buy a pair of trousers without turning in his old ones for scrap was conducted in modest undertones until Amos Keatow piped up, "I'd reckon 3 years."

"No, she was 4!" echoed from the far end of the table, where Joe Kerr presumed that Amos meant the age of Anne. "Her brother was 16, the grandfather 4·16=64 and the date 16·64=1024—all perfect squares."

"An anachronism," declared Ken Bridgewater. "The riddle bracketed the date between 1600, when Shakespeare wrote 'Comparisons are odious,' and 1936, the last square date 'some years ago,' both dates being inclusive. That eliminates AD 1024, but I can't fit 1600, 1681, 1764, 1849 or 1936 to the riddle."

Titus Wadham protested, "Add 1444 and 1521 to the bracket. Shakespeare's Dogberry said *odourous* paraphrasing Fortescue's *odious!* So Anne was 36, her brother 4, grandpa 36·4=144 and the year 1444, *combining* 144 and 4."

"Very unnatural," retorted Ken. "Two generations sired at 70! A 144-yr-old man, still thotful and able to write! A precocious 4-year old! His mother fertile for 33 years! If these improbables coincide, can a 36-year Anne be a *kid* sister to a 4-year-old?"

"Our Chairman looks anxious," interrupted the Professor, "so I'd better settle the argument. You are all equally correct, since Anne was 5 years old.

"Now for a more practical problem. You know how some Vermont farms seem to grow an annual crop of cobbles. Well our friend Ike N. Hall contracted to clear one for a lump sum. The cobbles were uniformly distributed over the farm, which was shaped like an isosceles right triangle and contained 20 acres. Ike had to haul the cobbles to make a single pile on one of the two legs of the boundary; what was the average haul? If it makes any difference, I'll add that, like most contractors, Ike was less than 144 years old, liked Euclid better than Newton, and knew his way around."

"Just a minute, Noah. Maybe Anne was 5 years old as you say, but I won't admit it until you prove it."

"Let me," begged Joe Kerr. "Problems are easy for me when I can work backwards from the answer. Anne's brother was 16 and grandpa was 5·16=80. The old man wrote the happy-birthday letter in 1680, saying nothing about squares. A few days later when the boy replied, it was AD 1681 and grandpa had had a birthday too."

Which no one denied, but the Professor barely escaped by the back door.

Bureau of Reclamation Is Recruiting Engineers

THERE is a big job ahead recruiting engineering personnel for the Bureau of Reclamation's Branch of Design and Construction in Denver, Colo. This office, headed by Chief Engineer Walker R. Young, M. ASCE, now employs 950, but needs 2,250 new engineers and engineering aides to meet its staff requirements for 3,200 by July 1.

To prepare designs and specifications for multiple-purpose projects in the Bureau's expanded peacetime program, this Branch has vacancies in various departments, chiefly for civil, electrical, mechanical, and structural engineers. While veterans are given preference, applications from the public at large are accepted. Applicants will be judged by their experience and training and will not be required to take written examinations. Salaries range from $2,320 to $5,180 a year for engineers, and from $1,572 to $2,980 for engineering aides.

Inquiries should be sent to the Bureau of Reclamation, Room 457, New Customhouse, Denver 2, Colo.

International Congress for Applied Mechanics to Be Held in Paris

AT THE Fifth International Congress for Applied Mechanics, held at Cambridge in 1938, a committee was formed to organize the Sixth Congress. Time and place for this Sixth Congress have now been decided on—at the Sorbonne in Paris from September 22 to 29, 1946.

The Congress will be divided into four sections, as follows:

1. Structures, Elasticity, Plasticity
2. Hydrodynamics and Aerodynamics, Hydraulics
3. Solid Dynamics, Vibration and Sound, Friction and Lubrication
4. Thermodynamics, Heat Transfer, Combustion, Fundamentals of Nuclear Energy

Those who desire to become members of the Congress are requested to inform the Secretary General as soon as possible. At the same time they should indicate whether they wish to present a paper, and in what section. Titles also should be submitted as soon as possible. Authors are asked to send to the Secretary General, before July 31, 1946, either the manuscript of their paper (maximum 5,000 words) or a summary of not more than 300 words. It is most desirable to have at least summaries of all the papers available at the time of the Congress in order to facilitate discussions. The Organization Committee hopes it will be able to have the summaries reproduced at the right time. However, it would be a great help if authors who have the facilities would prepare a number of copies of their summaries, or manuscripts, and send them to the Secretary or bring them to the meeting.

Adequate facilities will be provided for members for their stay in Paris. Excursions and visits to various institutions, places of scientific, historic, and artistic interest will be arranged.

The payment of a fee of 300 francs is required of members of the Congress; this fee can be paid immediately or not later than on the opening day of the Congress.

Communications are to be addressed to the Secretary General of the Sixth International Congress for Applied Mechanics, Institut Henri-Poincaré, 11, rue Pierre-Curie, Paris (*V*e).

New Traffic Movie

MANY engineers view the relief of traffic as involving an increase in facilities, while others see equal possibilities in economizing on facilities already available. Among the latter are those who advocate the use of electric transportation for the mass movement of persons.

This theme of economy of street use is graphically illustrated in a new color movie recently issued by the General Electric Company under the title, "Lifestream of the City." By photographs and pictograms it shows the utility of rapid transit, modern street cars (particularly the lively recent models), and the trolley bus.

City planners will doubtless find educational value in this 16-mm film. Inquiries should be addressed to Visual Instruction Section, General Electric Company, Schenectady, N.Y.

Examinations for Sanitary Engineers in Public Health Service

EXAMINATIONS for appointments as Assistant Sanitary Engineer and Senior Assistant Sanitary Engineer in the Regular Commissioned Corps of the U.S. Public Health Service are scheduled to be held at ten cities throughout the United States between April 15 and June 7. Compensation is as follows: (1) Assistant,

$3,411 with, and $2,975.50 without dependents; (2) Senior Assistant, $3,991 with, and $3,555.50 without dependents.

Applicants must be 21 years old and have the following training: (1) Assistant, at least 7 years of educational (exclusive of high school) and professional training or experience and a degree in sanitary engineering; (2) Senior Assistant, as above plus 4 additional years of postgraduate professional training or experience.

Applicants should write to the Surgeon General, U.S. Public Health Service, Washington, D.C., at the earliest practicable date, requesting application blanks and further particulars. The letter should include a brief biographical statement giving professional school or college attended, type of studies, degrees granted, and subsequent training or experience.

A.I.C.E. Chooses Officers for 1946

AT A MEETING on January 15, the Council of the American Institute of Consulting Engineers elected the following officers for 1946:

Enoch R. Needles, M. ASCE, President
George S. Armstrong, Assoc. M. ASCE, Vice-President
James Forgie, M. ASCE, Treasurer
Philip W. Henry, M. ASCE, Secretary

Mr. Needles replaces E. Rowland Hill, M. ASCE, in the office of president, but the other officers remain the same as last year.

NEWS OF ENGINEERS

Personal Items About Society Members

LEIF J. SVERDRUP, major general, Corps of Engineers, U.S. Army, announces that, after three and a half years of service in the Pacific area of war, he has returned to full participation in the activities of the St. Louis (Mo.) firm of Sverdrup and Parcel. Another change in the firm involving members of the Society is the admission to partnership of BRICE R. SMITH, former chief engineer, and D. C. WOLFE.

C. G. DANDROW, of White Plains, N.Y., was recently elected a vice-president of the Johns-Manville Sales Corporation and appointed general sales manager of the Power Products and Industrial Department, with headquarters in New York. He was previously New York district sales manager.

JOHN B. AICHER has resigned as civil engineer and land surveyor for the Trojan Powder Company in Allentown, Pa., in order to accept a position in a similar capacity with the Heyl-Bond-Miller Architects, also of Allentown.

FRANCIS J. LAVERTY, lieutenant colonel, U.S. Army, has returned to his position as civil engineer with the New York City Department of Public Works, and has been designated as chief of the sewage treatment section in the Bureau of Sewage Disposal. Colonel Laverty's last military assignment was as assistant public health officer in the Surgeon's office of the 12th Army Group. Prior to entering military service he was superintendent of the Wards Island Sewage Treatment Plant.

RALPH EBERLIN, colonel, Corps of Engineers, U.S. Army, has been awarded the Legion of Merit for his performance of outstanding duties as Chief of Operations and Control of Base Section, India-Burma Theater. The presentation was made during a recent ceremony in Calcutta. In civilian life Colonel Eberlin is vice-president of the Graham Construction Company and the City Housing Corporation, both of New York.

SIGMUND COHEN, until lately a major in the Corps of Engineers, U.S. Army, has returned to his position as associate structural engineer in the Detroit (Mich.) City Engineer's Office. Major Cohen spent three years on Army construction projects in the United States, followed by two years in the Burma-India Theater building B-29 bases and on the construction of the Stilwell Road.

VERNON H. SMITH announces that he was retired at the beginning of the year after more than thirty years of service with the Virginia Bridge Company and its predecessor, the Virginia Bridge and Iron Company. He has opened an office at 301 Union Planters Annex Building, Memphis, Tenn., and will engage in a general engineering practice, specializing in the designing and detailing of structural steel for bridges and buildings as well as pile and concrete foundations.

DEAN G. EDWARDS has become associated with CHARLES E. DE LEUW and GUY KELCEY in the practice of consulting engineering, with offices at 120 Broadway, New York 5, N.Y. Mr. Edwards is also associated with DeLeuw, Cather and Company, engineers of Chicago, Ill.

HERBERT S. RIESBOL, major, Corps of Engineers, U.S. Army, is now on terminal leave after three years' service at the Engineer School, Fort Belvoir, Va. He has accepted a position as senior hydraulic engineer for the U.S. Bureau of Reclamation in Denver, Colo., where he will be acting head of the Design Flood Section of the Hydrology Division. Before the war Major Riesbol was hydraulic engineer for the U.S. Department of Agriculture.

DONALD H. MCNEAL, formerly assistant to the president of James Stewart and Company, Inc., New York, N.Y., has been appointed vice-president and director of R. W. Hebard and Company, New York engineering and construction firm operating extensively in Latin America. Before his association with the Stewart firm Mr. McNeal was for eight years technical director for the Federal Home Loan Board and deputy general manager for the Home Owners Loan Corporation in Washington, for which he organized and directed all construction and appraisal work throughout the country.

CHARLES T. LEEDS, ARCHER F. BARNARD, RAYMOND A. HILL, and JOHN QUINCY JEWETT announce the formation of the Los Angeles consulting firm of Leeds, Hill, and Jewett, a partnership of Messrs. Leeds, Hill, and Jewett as successors to the consulting practice of Leeds, Hill, Barnard, and Jewett. They also announce the organization of Quinton Engineers, Ltd., of Los Angeles, a corporation under the direction of Mr. Barnard as president, and DONALD HULL MCCREERY as vice-president and general manager, to carry on the general engineering practice of the predecessor firm.

WILLIAM N. CAREY JR., lieutenant colonel, Corps of Engineers, U.S. Army, completed his terminal leave on February 5. He was engaged on airport construction from 1941 to 1944 and later had command of a battalion of the 93d Engineer-General Service Regiment. Colonel Carey has accepted a position on the engineering staff of the Highway Research Board of the National Research Council and will make his home in Washington, D.C.

OREN REED, construction engineer for the Tennessee Valley Authority, has just left Knoxville for a four-month trip to Brazil, where he will investigate and report on a proposed hydroelectric development on the San Francisco River. He is going on a "loan," which was arranged by the State Department, between the TVA and the Brazilian government.

HARRY E. BOVAY, JR., has resigned as mechanical engineer for the Humble Oil and Refining Company at Baytown, Tex., in order to establish a private consulting practice. He has opened offices in the Esperson Building, Houston, Tex., where he will specialize in the preparation of estimates, economic surveys, specifications, and contracts for buildings, structures, and industrial plants. During 1943 Mr. Bovay was senior materials analyst with the Petroleum Administration for War in Washington, D.C., where he set up and carried out a uniform system for handling projects in connection with all petroleum construction under Allied Nations control.

DAVID E. DONLEY, who has just been released from active duty as a lieutenant colonel in the Ordnance Department, U.S. Army, has accepted a position as hydraulic engineer in the Norfolk (Va.) District of the U.S. Engineer Department. He will be in charge of the hydrology unit of the Flood Control Branch and engage on hydrologic studies for the James and Roanoke rivers. Prior to his entry into the Army five years ago, Colonel Donley was hydraulic engineer for the Washington (D.C.) District of the U.S. Engineer Department.

CLIFFORD PETERSEN is at present a member of the staff of the University of Southern California in the capacity of aero research engineer. In addition, he is affiliated with the Marquardt Aircraft Company, for which he is in charge of a project for the development of a jet-propelled helicopter.

EDMOND H. LEAVEY, major general, U.S. Army, became chief of transportation, Army Service Forces, on December 1, 1945. He was formerly deputy commander and chief of staff of the U.S. Army Forces, Western Pacific.

JOHN W. CRENSHAW has resigned as chief engineer in the office of the post engineer at Camp Buttner, N.C., and will be associated with the engineering and architectural firm of Crenshaw and Jost, 512 Court Street, Pekin, Ill.

WALTER M. CULLEY, lieutenant colonel, Sanitary Corps, U.S. Army, has accepted a position as assistant sanitary engineer for the National Biscuit Company, with headquarters in New York City. For the past four years Colonel Culley was chief sanitary engineer for the Second Service Command, stationed at Governors' Island. Prior to entering the Army, he was engineer for the Chester (Pa.) Municipal Authority Water Service.

JAMES G. STEESE, assistant to the Governor of the Panama Canal, was recently decorated by General Brett, commander of the Caribbean Defense Command, with the Legion of Merit "for exceptionally meritorious conduct in the performance of outstanding services. . . . in the operation and defense of the Panama Canal."

KARL B. WAGNER announces that he has returned to civilian life after 32 months in the Civil Engineer Corps of the U.S. Navy, his rank at the time of separation being that of lieutenant. He will resume his connection with the E. L. Dalton Company, contractors of Dallas, Tex.

PAUL A. KELLY, formerly chief of military construction for the New York District of the Corps of Engineers, has become a member of the firm of Kelly and Gruzen, New York engineers and architects with offices at 220 Broadway.

EDWARD S. COLE has resigned as president of the Pitometer Company, New York, N.Y., but will continue to serve the organization in the capacity of consulting engineer. EGBERT D. CASE, previously vice-president and general manager, will succeed him as president. E. SHAW COLE now becomes vice-president and chief engineer, and CYRUS R. BIRD vice-president and Western manager.

GEORGE C. ERNST has accepted the position of associate professor of civil engineering at the University of Nebraska. Until lately he was with the Forest Products Laboratory at Madison, Wis., where he was in charge of the Timber Mechanics Laboratory.

ALBERT A. CASANI retired on January 1 as assistant to the president of the American Bridge Company, Pittsburgh, Pa., after many years of service with that organization. He was formerly assistant chief engineer.

JOSEPH J. GILBERT recently returned to the Link-Belt Company after wartime service with the Sanitary Corps of the U.S. Army, in which he attained the rank of lieutenant colonel. He has assumed the post of sales engineer in the Sanitary Engineering Division, with headquarters in Philadelphia, Pa.

RICHARD ELLIS is now vice-president of the Austin Company, the position representing a promotion from that of district manager for the Northwest district at Seattle, Wash. HAROLD A. ANDERSON, formerly Eastern district manager for the company in New York City, has been similarly promoted.

ARTHUR H. STARK has resigned as assistant bridge engineer for Cuyahoga County, Ohio, in order to accept an appointment as chief engineer for MARK SWISHER, general contractor and industrial engineer, of Cleveland.

MELVIN D. WILLIAMS retired on December 31 as district engineer in charge of the Alaska office of the Public Roads Administration, after 27 years in the service of the Administration.

ARTHUR J. BENLINE recently returned to his post as superintendent of the New York City Department of Housing and Buildings after a three-year leave of absence, in which he served as commander in the Civil Engineer Corps of the U.S. Naval Reserve. As commander of the 70th U.S. Naval Construction Battalion, he was awarded the Bronze Star Medal, and he was also a recipient of the Purple Heart Medal for wounds received in action on Okinawa.

ARTHUR B. SULLIVAN, after wartime service as major in the U.S. Army, is now on terminal leave and planning to take up residence in Redding, Calif., where he will do project planning for the U.S. Bureau of Reclamation. His most recent assignment was as post engineer at Benicia Arsenal, Calif.

ALFRED BRAHDY, until lately senior structural engineer for the New York City Board of Transportation, has been designated acting division engineer in charge of the design division.

WILLIAM R. HARDY has resumed his former position as sanitary engineer for the City of Fort Worth, Tex., after serving in the Sanitary Corps of the U.S. Army, with the rank of captain.

D. W. GRIFFITHS, district engineer for the U.S. Engineer Office at Galveston, Tex., was recently notified that he has been awarded the Croix de Guerre with palm. Colonel Griffiths was on General Eisenhower's staff overseas, and the award was made for service to France during its liberation.

ALFRED S. FULLER has opened a consulting office in Prescott, Ariz. He was previously on the engineering staff of the Fort Worth firm of Carter and Burgess.

MAXWELL M. UPSON, president of the Raymond Concrete Pile Company since 1931, has been elected chairman of the Board of Directors. He will be succeeded as president by WILLIAM V. MCMENIMEN, former vice-president.

DANIEL NOCE, major general, Corps of Engineers, U.S. Army, is now deputy commander and chief of staff of the Army Service Forces. Since his return from overseas service in May 1945, General Noce has been serving as director of plans and operations for the Army Service Forces and more recently was acting chief of staff.

WILLIAM H. PENFIELD announces that he is retiring, at his own request, as chief engineer of the Chicago, Milwaukee, St. Paul and Pacific Railroad after many years in the service of the company. He will be succeeded by ROBERT J. MIDDLETON, former assistant chief engineer.

RALPH S. HOWARD, JR., previously associate chief of the engineering division of the U.S. Public Health Service at Atlanta, Ga., has been made public works superintendent of Dougherty County, Georgia.

ALBERT BAUER is now assistant general manager of the Swan Island Shipyard at Portland, Ore. Until lately he was with the Oregon Shipbuilding Corporation in a similar capacity.

JACK Y. LONG, previously senior design engineer for the Kaiser Industries at Oakland, Calif., has formed an engineering organization in Oakland, to be known as the J. Y. Long Company. The new organization will specialize in structural design, general civil engineering, and land surveys.

O. A. ZIMMERMAN has accepted a position as construction engineer with the Maxon Construction Company, of Dayton, Ohio. He was formerly assistant manager for Doullut and Ewin, of Mobile, Ala.

EUGENE B. SULLIVAN has been appointed director of public works for East Hartford, Conn., following his discharge from the Corps of Engineers, U.S. Army, in which he held the rank of captain. His most recent assignment was as assistant chief of the management branch of the Repairs and Utilities Division, Third Service Command Engineers.

JAMES K. CARR was recently appointed district engineer in charge of the newly established office of the U.S. Bureau of Reclamation at Sacramento, Calif. He was previously associate engineer for the Bureau on the Central Valley Project.

CHARLES L. HALL, colonel, Corps of Engineers, U.S. Army, has been awarded the Distinguished Service Medal for his wartime services as division engineer at Columbus, Ohio. His present assignment is as division engineer for the North Atlantic Division at New York.

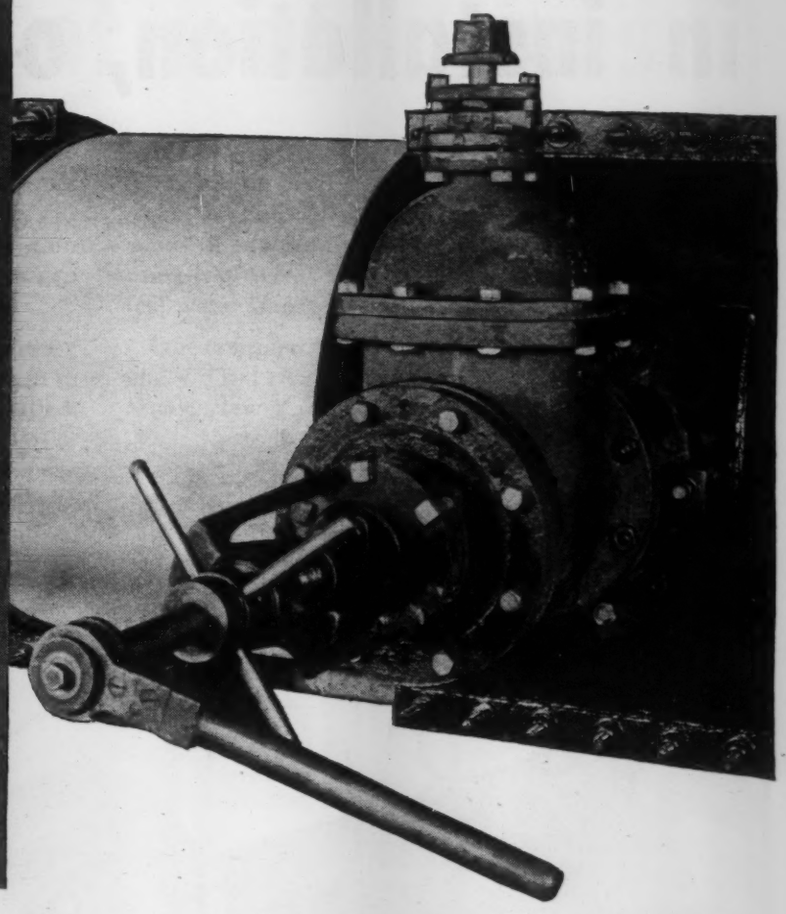
C. A. DOWNING, formerly research engineer for the Vermiculite Research Institute, Evanston, Ill., was recently elected executive secretary of the New York State Bituminous Concrete Producers Association. His office will be in the DeWitt Clinton Hotel, Albany 7, N.Y.

G. A. DUNWOODY, who is on terminal leave from the Corps of Engineers, U.S. Army, in which he had the rank of captain, announces that he has formed an engineering partnership with John E. Brink, former chief engineer of the federal work program in Kansas. The new firm will have offices at Iola, Kans.

CLYDE E. SWANK has accepted the position of city manager of Fort Pierce, Fla. Since 1940 he has been city manager of Panama City, Fla.

ADVANTAGES OF PRESTRESSED CONCRETE CYLINDER PIPE • NO. 5

Easily and economically tapped...



• Prestressed Concrete Cylinder Pipe can be readily tapped under full operating pressure. This eliminates the necessity for dewatering the line when making connections not originally contemplated at the time of construction. The work can be done by regular maintenance crews with their own equipment.

Reducers, wyes, tees and elbows are made according to standard Lock Joint Pipe design ... and constructed to meet every type of field condition. Prestressed Concrete Cylinder Pipe may be somewhat new to you *now* ... but already hundreds of thousands of feet have been installed and additional hundreds of thousands of feet are under contract on major projects throughout the Western Hemisphere. In the meantime, let us help your engineers plan your next job and show you the advantages of specifying Prestressed Concrete Cylinder Pipe in sizes of 16" to 84"—and even larger—for high pressure pipelines.

A Hazen-Williams Hydraulic Slide Rule will gladly be sent upon request with our compliments.

LOCK JOINT *Reinforced Concrete* **PRESSURE PIPE**

LOCK JOINT PIPE COMPANY

Established 1905

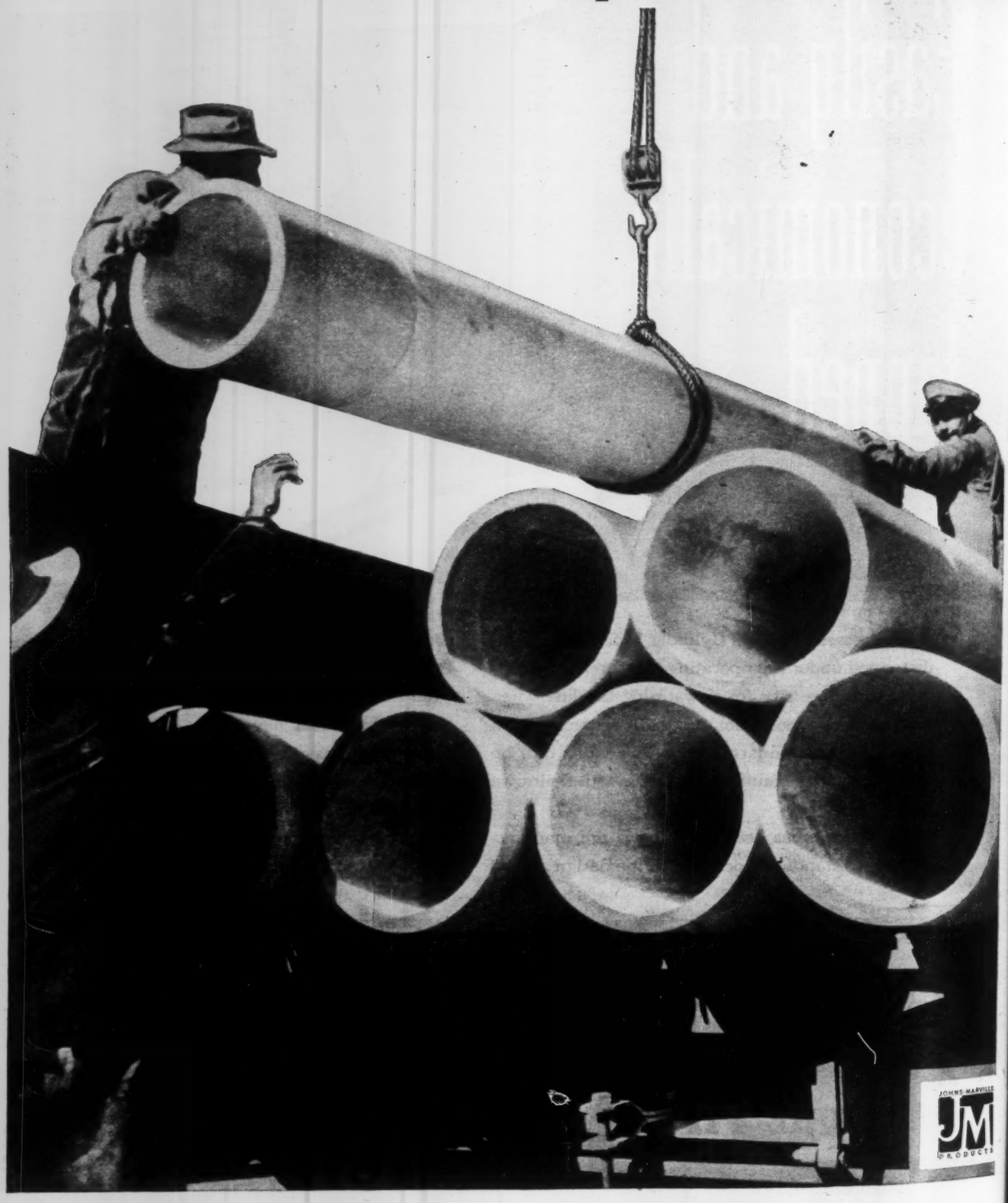
P. O. BOX 269, EAST ORANGE, NEW JERSEY

Denver, Colo. · Chicago, Ill. · Kenilworth, N. J. · Kansas City, Mo. · Rock Island, Ill.
Joplin, Mo. · Valley Park, Mo. · Cleveland, Ohio · Hartford, Conn. · Navarre, Ohio

SCOPE OF SERVICES *Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous lines.*

WHERE and HOW

in installation, operation and



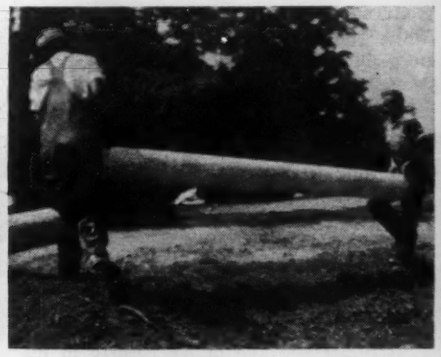
to REDUCE COSTS
maintenance of water lines

FROM its low initial installation cost to its far-reaching economies over the years . . . in both water transmission and distribution lines . . . TRANSITE PRESSURE PIPE can save you money.

Made of asbestos and cement, this modern pipe can't tuberculate . . . is highly resistant to soil corrosion. Easily handled and installed, it maintains high delivery capacity . . . forms tight yet flexible joints. It is used by thousands of communities all over the country because it provides more efficient, more economical water transportation year after year.

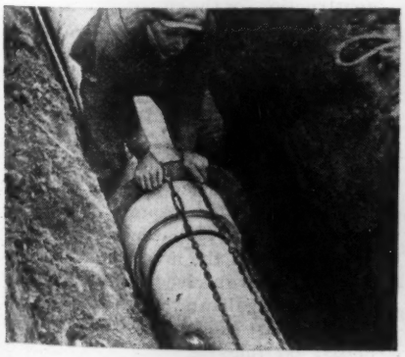
For complete information, write for brochure TR-11A. Johns-Manville, 22 East 40th Street, New York 16, N. Y.

TRUCKING COSTS hit bottom with Transite! Its light weight means more footage carried per truckload—time and money saved in transporting this pipe to the job.



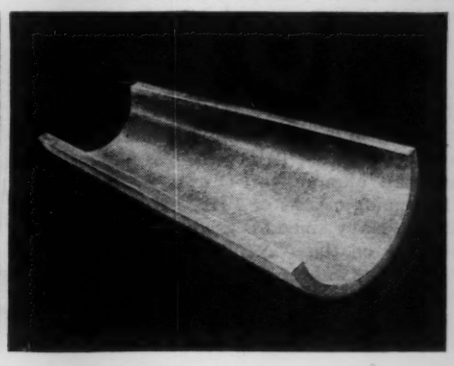
HANDLING COSTS too, are low. Fewer man-hours are required for unloading and lowering into the trench. Only the larger sizes require mechanical handling equipment.

EXCAVATING COSTS, as shown above, are low with Transite. Trenches are narrow and disturbance to pavement is kept to a minimum. No bell holes are required at the joints.



ASSEMBLY COSTS drop with Transite. The Simplex Coupling permits quick, easy assembly . . . assures joints that stay tight, even when the line is deflected as much as 5° at each coupling.

MAINTENANCE COSTS are cut with Transite. Its tight joints, high uniform strength, proven durability and corrosion-resistance all contribute to its economical performance.



OPERATING COSTS stay low because this asbestos-cement pipe cannot tuberculate. As a result, its delivery capacity (C-140) remains high; pumping costs are minimized.

Johns-Manville TRANSITE PIPE

DECEASED

CHARLES FRANCIS CHASE (M. '02) president of the Berlin Construction Company, Inc., Berlin, Conn., died at New Britain, Conn.; on December 28, 1945. Mr. Chase, who was 81, had been with the Berlin Construction Company since 1900—for many years in the capacity of chief engineer. Earlier in his career (1890 to 1900) he was with the Berlin Iron Bridge Company.

ISIDORE COHEN (M. '16) construction cost analyst for the Federal Public Housing Authority, Atlanta, Ga., died on December 27, 1945. Mr. Cohen, who was 72, spent his early career with the Chicago architectural firm of Burnham and Root, with which he was associated for 20 years in the capacity of structural engineer. Later he was chief structural engineer for the Witherspoon-Engler Company, grain elevator engineers, and engineer for Starrett Brothers, of Chicago. More recently he was with the Federal Public Housing Authority in Washington, D.C., and Atlanta.

GILBERT COLFAX DOBSON (M. '19) former chief of the Sedimentation Section of the U.S. Soil Conservation Service, died on December 29, 1945, in Tulsa, Okla., where he had been living since his retirement in 1943. He was 64. Early in his career Mr. Dobson was engaged in surveying work in the Philippines, and he had also been assistant city engineer of Manila. Then (1910 to 1916) he was in Panama, where he was field engineer on the construction of the Gatun Spillway and Locks. During the first World War he served overseas, with the rank of major. Later he was field engineer for the Portland Cement Association, and from 1929 to 1935 was in private practice in Tulsa. In the latter year he became connected with the Soil Conservation Service.

GEORGE HERBERT ECKARDT, JR. (Jun. '42) lieutenant (jg), U.S. Naval Reserve, has been missing in action since December 5, 1944, and was officially declared dead on December 6, 1945. He was about 25, and an alumnus of Drexel Institute of Technology, class of 1942. He had been in the Navy since his graduation and was serving on the *U.S.S. Scamp*, when that submarine was reported overdue and failed to return from patrol operations in the Pacific area. His home was in Philadelphia, Pa.

ALBERT FRIEDERICH FISCHER (M. '23) vice-president of Armco Drainage and Metal Products, Inc., of Des Moines, Iowa, died in Iowa City on December 17, 1945, at the age of 59. From 1912 to 1913 Mr. Fischer was in the city engineer's office at Clinton, Iowa, and from 1914 to 1922 he was highway engineer of Jefferson County, Iowa. Later he was for some years general manager of the Iowa Culvert and Pipe Company. Mr. Fischer invented a road maintainer and a metal head wall for corrugated culverts.

GEORGE HAMILTON GREENWOOD (Assoc. M. '41) lieutenant, Civil Engineer Corps, U.S. Navy, died in January 1945 while a prisoner of war of the Japanese. Lieutenant Greenwood, who was 37, graduated from the University of California in 1929. For the next ten years he was with the California Division of Highways, serving successively as junior highway engineer and assistant highway engineer. In May 1941 he became a lieutenant (jg) in the U.S. Naval Reserve and was stationed at Cavite in the Philippines.

ALEXANDER JOHN GRIFFIN (Assoc. M. '43) engineer for the Dunbar and Sullivan Dredging Company, Detroit, Mich., died on April 5, 1945, at the age of 52. From 1913 to 1915 Mr. Griffin was with the New York State Canal Terminal Department, and from 1915 to 1925 with the Empire Engineering Company, of New York City. Since the latter date he had been with Dunbar and Sullivan—first as superintendent of work on the Great Lakes, and from 1936 to 1941 as engineer in charge of work on the New York State Barge Canal.

GEORGE FREDERICK HARTMAN (Jun. '38) assistant engineer for the U.S. Engineer Office at Seattle, Wash., died on November 8, 1945. His age was 32. Following his graduation from the University of Washington in 1938, Mr. Hartman became junior structural engineer for the U.S. Bureau of Reclamation on the construction of Coulee Dam. In 1941 he transferred to the U.S. Engineer Department.

THEODORE REED KENDALL (M. '30) engineer and editor of New York, N.Y., died in a hospital in that city on February 4, 1946, at the age of 55. Early in his career Mr. Kendall was water chemist for the Panama Canal. Then (in 1917) he was named engineering editor of *The American City*, a post he held until 1938, except for a period of war service, with the water supply section of the Army Sanitary Corps. Coincidentally, from 1920 until his death, Mr. Kendall was editor of *Contractors and Engineers Monthly*, a business periodical for construction firms and highway officials, of which he was a founder.

HENRY KERCHER (M. '28) vice-president and general manager of the Broadway and Newport Bridge Company, Newport, Ky., was fatally stricken while entering his car on January 8, 1946. He was 58. From 1912 to 1923 Mr. Kercher was with the King Bridge Company of Cleveland, serving successively as assistant engineer, chief draftsman, and assistant chief engineer; and from 1923 to 1930 was design engineer for the Cleveland Union Terminals Company. Since 1931 he had been vice-president and general manager of the Broadway and Newport Bridge Company. Mr. Kercher was a resident of Cincinnati, and a former president of the Cincinnati Section.

GEORGE MUSTIN LEHMAN (M. '11) of Philadelphia, Pa., died at his home in that city on January 19, 1946, at the age of 82. Much of Mr. Lehman's career centered about the Lake Erie and Ohio River Ship Canal—he was principal assistant engineer in charge of surveys and plans for the project, and later was chief engineer of the Lake Erie and Ohio River Canal Board, retiring about two years ago. He had also made many surveys for railroads and canals in Pennsylvania and adjacent states, and at one time was head of the Pittsburgh Flood Commission in charge of investigations, surveys, and plans for flood protection and prevention.

LOUIS ADOLPH MITCHELL (M. '15) engineer for the Indiana State Highway Department, Indianapolis, Ind., died on January 3, 1946, at the age of 68. Mr. Mitchell was for many years connected with the Union Traction Company, at Anderson, Ind., serving as engineer of maintenance of way and, later, as chief engineer. From 1941 until recently he had been an engineer in the Allison Division of the General Motors Corporation at Indianapolis, Ind.

JOHN DONALD MITSCH (Assoc. M. '35) associate professor of civil engineering at Massachusetts Institute of Technology, Cambridge, Mass., was killed in a transport plane crash at Cheshire, Conn., on January 18, 1946. Professor Mitsch, who was 48, spent most of his career on the Massachusetts Institute of Technology staff, having gone there as an instructor in 1923. He had been associate professor since 1940. During the recent war Professor Mitsch served as a student military adviser and liaison officer.

PHILLIPS BATHURST MOTLEY (M. '15) retired engineer of bridges for the Canadian Pacific Railway, Montreal, Canada, died in a hospital in that city on January 13, 1946. Mr. Motley, who was 74, was born in India and educated in England. Upon his arrival in Canada in 1892, he became connected with the Canadian Pacific Railway. In 1908 he was made assistant engineer of bridges, and from 1911 until his retirement in 1937 he was engineer of bridges in charge of design and construction for the entire system.

HAROLD LESTER ODOM (Jun. '41) of Jonesboro, La., was killed in an automobile accident near Hood River, Ore., on January 7, 1946. He was 28, and an alumnus of Louisiana State University, class of 1941. Mr. Odom was sent overseas with the Marine Corps in April 1942. Later he became a captain and company commander, participating in the invasion of Tarawa and the invasion and battle of Saipan. He received the Silver Star Medal for gallantry in action and the Purple Heart Medal for wounds. He was placed on inactive duty as a major in December 1945.

GLENN L. PARKER (M. '21), Director of the Society 1939–1940, died suddenly on February 12 in Washington, D.C. Mr. Parker was chief hydraulic engineer of the U.S. Geological Survey, having been connected with the Survey since 1909. A more complete account of his life appears in the "Society Affairs" section of this issue.

HENRY GARFIELD PERRING (M. '18) consulting engineer and architect of

THE International TD-6 Diesel TracTracTor is a flexible, easily maneuvered crawler that's packed full of economical power to meet an unusually large number of power requirements.

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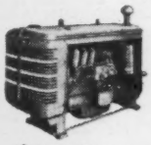
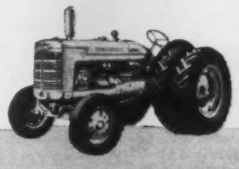
TRACTRACTORS


POWER UNITS


WHEEL TRACTORS

INTERNATIONAL Industrial Power

Baltimore, Md., died on January 25, 1946, at the age of 64. From 1905 to 1909 Mr. Perring was chief engineer for the Keystone Fireproofing Company, of Philadelphia; from 1909 to 1910, general manager of the Sagax Wood Company, of Baltimore; and from 1911 to 1920, consulting engineer, with offices in Baltimore. From 1920 to 1928 he was chief engineer for the City of Baltimore and supervising engineer for the Public Improvement Commission. And from the latter year on he maintained an engineering and architectural practice—at the time of his death as a member of the firm of Perring and Remington.

DEAN EDWIN SWIFT (Jun. '35) colonel, Corps of Engineers, U. S. Army, died of poliomyelitis in Manila, P. I., on January 7, 1946. Colonel Swift, who was 33, graduated from Kansas State College in 1935, and received a master's degree in civil engineering from Massachusetts Institute of Technology in 1938. He entered the Corps of Engineers, with the rank of second lieutenant, in 1937, and at the time of his death was in command of the 1061st Engineer Port Construction and Repair Group. His home was in Bogard, Mo.

VALENTINE V. TCHIKOFF (M. '34) of Greenbelt, Md., died there on October 7, 1945, at the age of 61. Born and educated in Russia, Mr. Tchikoff spent his early career there. Coming to the United States in 1916 as a member of the Russian Military Purchasing Committee, Mr. Tchikoff remained here. He maintained a consulting practice in New York and later was chief of the technical department of the Arcos and Amtorg Trading Corporation, of New York. In 1929 he returned to Russia for two years as assistant engineer to the late Arthur P. Davis on a review of reclamation projects in the Soviet Union. He became project analyst for the Farms Security Administration in 1935, later transferring to the Public Housing Administration. Mr. Tchikoff was the author of widely used texts on irrigation, water power, and agricultural engineering.

FREDERICK WAZNEY TOWNROW (Assoc. M. '24) structural designer for the Koppers Company, Pittsburgh, Pa., died at his home in Canonsburg, Pa., on January 5, 1946, at the age of 72. From 1902 to 1925 Mr. Townrow was with the Fort Bridge Works, of Pittsburgh, in varying capacities, and from 1925 to 1931 structural designer for the Koppers Company. Later he was engineer for the County (Washington) Emergency Relief Board, and project engineer for the WPA. He resumed his connection with the Koppers Company in 1942.

JAMES COXEY TRAVILLA (M. '20) of University City, Mo., died recently. He was about 80. For a number of years (1890 to 1913) Mr. Travilla was with various public works departments in St. Louis—from 1907 to 1913 as a member of St. Louis Board of Public Improvement and as street commissioner. From 1917 to 1920 he was a consulting highway engineer in St. Louis, representing the Dunn Wire-Cut Lug Brick Company, and from 1920 until his retirement about two years ago he was in charge of the Pilot Knob Ore Company, a rock-crushing plant (later called Pilot Knob Volcanic Trap Rock Products).

RALPH WHITMAN (M. '14) rear admiral, Civil Engineer Corps, U.S. Navy (retired), died at his home in Danbury Conn., on February 3, 1946. Admiral Whitman, who was 65, had been in the Navy since 1907. In 1917 he was appointed technical adviser on public works to the military governor of Santo Domingo, and later received a special letter of commendation with the Silver Star for his engineering and administrative services there. On his return to the United States in 1920, he became officer in charge of construction at the Naval Ordnance Plant at South Charleston, W.Va. Later assignments took Admiral Whitman to the Bureau of Yards and Docks in Washington, D.C.; the Norfolk (Va.) Navy Yard; and the Mare Island (Calif.) Navy Yard. From 1939 until his retirement a year ago he was stationed at the headquarters of the Third Naval District in New York.

WILLIAM HENRY YATES (M. '13) civil engineer of New York, N.Y., died on January 28, 1946, at the age of 70. From 1903 to 1907 Mr. Yates was an instructor at his alma mater, Columbia University; from 1907 to 1911, in the design department of the New York Board of Water Supply; and from 1911 to 1915, supervising engineer for the New York State Barge Canal. He was later associated with the City of New York as division engineer, Department of Marine and Aviation, from which position he retired a few years ago.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From January 10, to February 9, 1946, Inclusive

ADDITIONS TO MEMBERSHIPS

ABBOTT, ROBERT KENT (Jun. '45), 5218 Zenith Ave. South, Minneapolis, Minn.

ANSCHICKS, ROBERT DAVID (Jun. '45), Ensign, CEC, U.S.N.R.; 157 South Delaplaine Rd., Riverside, Ill.

AUSLAND, WILLIS MYRON (Assoc. M. '45), 300 South 6th St., Grants Pass, Ore.

BALITZ, ARTHUR ROBERT (Jun. '45), Ensign, CEC, U.S.N.; 1100 Lillian St., Hobart, Ind.

BARRY, WALTER ANDRESS, JR. (Jun. '45), Ensign, CEC, U.S.N.R., Mare Island Naval Shipyard, Mare Island (Res., 920 Virginia St., Vallejo), Calif.

BASCUR HERRERA, JORGE (Jun. '45), Ingeniero, Empresa Nacional de Electricidad S.A., Ramon Nieto 920, Santiago, Chile.

BAUM, VINCENT HENRY (Jun. '45), Asst. City Engr., City of Rye, Square House (Res., 172 Wagner Sq.), Rye, N.Y.

BEDFORD, CLAY PATRICK (M. '45), Vice-Pres. in Chg. of Mfg., Kaiser-Frazier Corp., Willow Run, Mich.

BERTONE, ANTHONY CONCETTINO (Jun. '45), Ensign, CEC, U.S.N.; 849 East 228th St., New York 66, N.Y.

BROWN, DALTON (Jun. '45), with U.S.N.; Route 10, Box 481, Milwaukee 2, Ore.

BUCKIUS, ORLAND EDWIN (Assoc. M. '45), Junior Civ. Engr., City Water Div., 111 City Hall (Res., 2318 C St.), Sacramento, Calif.

CALLAWAY, JOHN LEA (Assoc. M. '45), Mgr., Constr. Materials, Connors Steel Co., P. O. Drawer 952 (Res., 1413 Primrose Pl.), Birmingham 9, Ala.

CANDOO, ALEXANDER DAVIS (Jun. '45), Seaman 1/c, U.S.N.R.; 4124 North Huson, Tacoma, Wash.

CARTER, GERALD ROBERT (Jun. '45), Associate Engr., Marion L. Crist & Associates, 508 Union Life Bldg., Little Rock, Ark.

CHUN, EDWIN HINTUNG (Assoc. M. '45), Engr., U.S. Engr. Office, 1217 U.S. Postoffice & Customhouse (Res., 880 Burr St.), St. Paul 1, Minn.

CLUNN, HOWARD ACKLEY (Jun. '45), Ensign, CEC, U.S.N.R., Design Office, Public Works Dept., Naval Base, Norfolk, Va.

COHEN, EDWIN ROY (Jun. '45), Electronic Technicians Mate 3/c, U.S.N.R., Company 208, Billet 431, Navy Pier, Chicago, Ill.

COMPAGNO, RALPH EDWARD (Jun. '46), Ensign, U.S.N.R.; 932 Nashville Ave., New Orleans, La.

CORNER, SHERWOOD LAMSON (Jun. '45), Storekeeper 3/c, U.S.N.R., U.S.N. Persepcen, Disbursing Dept., Minneapolis 6, Minn.

CRANSTON, GEORGE EDWARD (Jun. '45), Ensign, CEC, U.S.N.R.; 6803 Bliss Terrace, Brooklyn, 20, N.Y.

CREA, LEWIS ALAN (Jun. '45), Ensign, CEC, U.S.N.R.; Fenn, Idaho.

CROFT, DONALD JUDSON (Jun. '45), Field Engr., Dames & Moore, 1504 Russ Bldg., San Francisco 4, Calif.

CULLY, RAYMOND JOHN (Jun. '45), 157 Humber Ave., Buffalo 15, N.Y.

CURNUTTE, JAMES VENCILL (M. '46), Cons. Engr., 123 Ogden Lane (Res., 205 Redwood), San Antonio 2, Tex.

DALAKOW, EGNATEY AFANACY (Assoc. M. '45), (Montana Eng. & Constr. Co.), Box 823, Helena, Mont.

DEGLING, ALBERT OTTO (M. '46), Asst. Mgr., Constr. Div., Am. Can Co., 230 Park Ave., New York, N.Y. (Res., 121 Baker St., Maplewood, N.J.)

DE LUCCIA, EMIL ROBERT (M. '45), Chf., Bureau of Power, Federal Power Comm., Washington, D.C. (Res., 714 South Overlook Drive, Alexandria, Va.)

DERBY, EDWARD MONROE (Assoc. M. '45), Asst. Bridge Engr., State Div. of Highways, Public Works Bldg. (Res., 2774 Harkness Way), Sacramento 14, Calif.

DROESCH, EDWARD ANTHONY (Assoc. M. '45), Engr. (Civ.), U.S. Engr. Office, Box 1234, Cincinnati, Ohio.

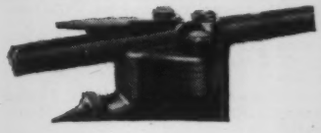
DUTCHER, GEORGE WALLACE (Assoc. M. '46), Senior Civ. and Architectural Engr., Design Div., E. I. du Pont de Nemours & Co., Inc. (Res., 112 Catalpa Ave.), Wilmington 131, Del.

FINCH, HERMAN FRANCIS (M. '45), Chf., Materials Control Section, The Panama Canal, Box 163, Balboa Heights, C.Z.

FLEMING, MATTHEW JOHN (M. '46), Chf. Engr., DeLeuw Cather & Co., 20 North Wacker Drive, Chicago, Ill. (Res., 110 St. Clair Ave., West, Toronto, Ont., Canada.)

ANNOUNCING...

a new Gardner-Denver postwar breaker with the NEW SAFETY LATCH



It's a *postwar* Paving Breaker, in every sense of the word—this new Gardner-Denver Model B87! Thanks to the new Gardner-Denver safety latch—an exclusive feature—this breaker can be moved from place to place or from level to level on the job without shutting off the air—and without danger of injury to the operator. The throttle cannot open accidentally because the safety latch holds it securely against accidental openings. Quickly engaged or disengaged by a flip of the operator's thumb, the new latch works like the "safety" on the trigger of a gun—prevents accidents before they happen. Other new features of the B87 are—

SHORT WHERE IT COUNTS—*The B87 is shorter from top of gad to holding handles. It's easier to operate with standard length chisels and gads—more comfortable to operator when longer points are necessary.*

NO AIR OR OIL LEAKAGE—*Joints on the B87 breaker are not under air pressure—no wasteful nor annoying leakage of air or oil.*

FIVE-HOUR LUBRICATION—*Built-in lubricator holds enough oil for five hours of normal operation. Lubrication is positive to every working part, including gads.*

COOL HANDLES—*Heated air cannot cause discomfort to operator because air inlet is at side of cylinder and not through backhead.*

RENEWABLE CHUCK LINER—*No need to replace the entire chuck end when chuck wears to a loose fit of the gad shank. Renewable liner makes this repair quick and easy.*

TOOL RETAINER—*Extra heavy forged retainer pivots on substantial pin held positively in place. No nut to become loose.*

CONVERTIBLE TO SHEETING DRIVER—*The B87 is convertible to a sheeting driver by removing the standard chuck end and substituting a jaw-type sheeting driver head. Jaw assemblies adjustable to take up to 3-inch sheeting are available.*

GARDNER-DENVER
Since 1859

Gardner-Denver Company, Quincy, Illinois

FREY, WILLIAM OLDFIELD (Jun. '45), Ensign, CEC, U.S.N.R.; 209 Vale, Bloomington, Ill.

FRITZ, NORBERT BENNETT (Jun. '45), Engr., McMahon Eng. Co., Menasha, Wis.

FYALKA, JOHN JOSEPH (Jun. '45), Ensign, CEC, U.S.N.R.; Room 425 Everglades Hotel, Miami, Fla.

GARDNER, MAURICE HYDE (Jun. '45), Ensign, U.S.N.R.; 3830 North East 32d Pl., Portland, Ore.

GOODALL, DAVID MELVIN (Assoc. M. '45), Maj., Corps of Engrs., U.S. Army, Office, Chf. of Engrs., Washington, D.C. (Res., 4906 South 29th Rd., Arlington, Va.)

GOODELL, HARVEY LEEPER (M. '46), Chf. Engr., Maxon Constr. Co., Inc., 131 North Ludlow (Res., 262 Victor), Dayton 5, Ohio.

GROH, ANTHONY JOHN (Jun. '45), Div. Officer, U.S.N.; 825 West 3d St., Appleton, Wis.

GUNLOCK, VIRGIL EMMETT (M. '45), Commr., Subways and Superhighways, City of Chicago, 20 North Wacker Drive (Res., 525 Arlington Pl.), Chicago 14, Ill.

HALE, DUANE HARLYN (Jun. '45), Ensign, CEC, U.S.N.R.; 642 North Dawson St., Uhrichsville, Ohio.

HEINEN, ROGER JAMES (Jun. '45), Ensign, CEC, U.S.N.R.; 4712 West Washington Blvd., Milwaukee 8, Wis.

HEXEM, LEWIS GILBERT (Assoc. M. '46), Design Engr., Hazelet & Erdal, 53 West Jackson Blvd., Chicago 4, Ill.

KING, RICHARD LOUIS LYNDEN (Jun. '45), Ensign, CEC, U.S.N.R.; Constr. Battalion Maintenance Unit 618, Care, Fleet Post Office, San Francisco, Calif.

LATHLAEN, ROBERT FRANK (Jun. '45), 417 East Durham St., Philadelphia 19, Pa.

LAVERS, WILLARD DOUGLAS (Assoc. M. '46), Dept. Supt., Clinton Engr. Works, Tennessee Eastman Corp. (Res., 98 Orchard Lane), Oak Ridge, Tenn.

LEBIDINE, SAMUEL PAUL (Jun. '45), Private, U.S. Army; 7914 Pickering St., Philadelphia 19, Pa.

LEE, HENRY HSIEN-LI (Jun. '45), Private First Class, U.S. Army; 1168 Jackson St., San Francisco, Calif.

LEONTOVICH, VALERIAN MICHAEL (Assoc. M. '45), Structural and Research Engr., Joslyn & Ryan, 149 New Montgomery, San Francisco (Res., 1028 Cowper St., Palo Alto), Calif.

LINDBERG, ROBERT HENRY (Jun. '45), 229 Thirty-Sixth North, Seattle 2, Wash.

LINDNER, CHARLES WILLIAM (Jun. '45), Ensign, CEC, U.S.N.; 8358 Wiswell Ave., Cincinnati 15, Ohio.

LOCK, EVERARD JOHN GRAHAM (Jun. '45), Asst. Civ. Engr., Messrs. John Mowlem & Co., Ltd., 91, Ebury Bridge Rd., S.W. 1, Westminster (Res. 96, Shakespeare Rd., Hanwell, London, W. 7), England.

LOGAN, JOHN ALEXANDER (Assoc. M. '45), Maj., San. Corps, U.S. Army; 102 Laurier Ave., Yorkton, Sask., Canada.

LYNESS, ROBERT MARRON (Jun. '45), Ensign, CEC, U.S.N.R.; 4471 Thirty-Fourth St., San Diego 4, Calif.

MAHONEY, VERNON LLOYD MIKE (Jun. '45), Seaman 1/c, U.S.N.R.; 401 East 5th St., Tucson, Ariz.

MANDIGO, JAMES ALLEN (Assoc. M. '45), U.S. Army; With Black & Veatch, Cons. Engrs., 4706 Broadway (Res., 307 East Dartmouth Rd.), Kansas City, Mo.

MARTIN, JOHN FRANKLIN (Assoc. M. '45), Lt., Comdr., U.S. Coast Guard; 419 Malden Ave., Seattle, Wash.

MATYAS, CURT ANTON (Jun. '45), Ensign, CEC, U.S.N.; Route 11, Box 714, West Allis, Wis.

MILLS, WILLIAM HAYNE (M. '45), Lt. Col., Corps of Engrs., U.S. Army; 3522 Meredith Lane, Columbia, S.C.

MILNES, LAURENCE WILBER (Jun. '45), Ensign, U.S.N.R.; 528 Magnolia Ave., Modesto, Calif.

MINICONE, LORENZ MAURICE (Jun. '45), Ensign, CEC, U.S.N.R.; 107 North Grove St., Valley Stream, N.Y.

NELSON, ROBERT DWIGHT (Jun. '45), Ensign, U.S.N.; Route 3, Clifton, Kans.

NOVIE, CONSTANTINE ALEXANDER (Assoc. M. '45), Associate Engr. (P-3), U.S. Engrs. (Res., 1106 Lakeview Blvd., Seattle 2), Wash.

O'FARRELL, JOHN JOSEPH (Assoc. M. '45), Mgr., Procurement Div., Kaiser Co., Inc., Vancouver, Wash. (Res., 3416 North East 38th Ave., Portland 13, Ore.)

OSBERG, ALLAN FREDERICK (Jun. '45), Route 3, Box 286, Bothell, Wash.

PALMA VIAL, CARLOS (Jun. '45), Ingeniero, Empresa Nacional de Electricidad, Ramon Nieto 920, Of. 312, Santiago, Chile.

PARK, JAMES FLETCHER (Jun. '46), Labor Foreman, R. P. Farnsworth & Co., Inc., Box 74, Houston, Tex.

PAVLOW, FRED (Jun. '45), Asst. Civ. Engr., CEC, U.S.N.; 3910 Fulton St., San Francisco 18, Calif.

PETTIKAS, TOM LEON (Jun. '45), Ensign, CEC, U.S.N.R.; 1720 Pilgrim, Detroit, Mich.

POLATTY, JAMES MARION (Assoc. M. '45), Ensign, CEC, U.S.N.R., Constr. Battalion 1087, Care, Fleet Post Office, San Francisco, Calif.

PORCELLI, JOHN DOMINIC (Jun. '45), Lt. (jg), U.S.N.R.; 35–10 Thirty-Fifth St., Astoria, N.Y.

POTTER, CLARKE JAMES (Jun. '45), Div. Engr., Cia. Raymond-Morrison-Knudsen, Caiza Postal 50, Vitoria, Brazil.

QUINONES GONZALEZ, RAUL AUGUSTO (Assoc. M. '45), Chf. Engr. Administration, Central Hydroelectric Corp. of Peru, Lima Edificio Boza 5° Piso (Res., Huarez 433), Lima, Peru.

REEVES, ROBERT EUGENE (Jun. '45), Ensign, U.S.N.R.; 1396 South Main St., Salt Lake City 4, Utah.

SCATUORCHIO, DOMINIC NICHOLAS (Jun. '46), Insp., Starrett Bros. & Eken, Inc., 63 Wall St., New York, N.Y. (Res., 340 Stegman Parkway, Jersey City 5, N.J.)

SMITH, HUGH ADAMS, JR. (Jun. '45), Jun. Engr., U.S. Engrs., Bonneville, Ore.

STALLMAN, ROBERT WILLIAM (Jun. '45), 445 North Pennsylvania St., Room 205, Indianapolis 4, Ind.

STRASSER, ROBERT LINCOLN (Jun. '45) (R. J. Strasser & Sons), Route 3, Box 594, Portland (Res., 603 Jackson St., Oregon City), Ore.

STUFFLEBEAN, JOHN HOWARD (Jun. '46), Instrumentman, Southern Pacific Co., Div. Engr.'s Office (Res., 1727 East 6th St.), Tucson, Ariz.

STURGIS, WAYNE FLEENOR (Jun. '45), 76 Sea View Ave., Piedmont 11, Calif.

SWANSON, JOHN EDWARD, JR. (Jun. '45), 2d Lt., U.S.M.C.R., B.O.Q., Courthouse Bay, Engr. Battalion, Camp Le Jeune, N.C.

UHLMANN, PAUL ADOLPH (M. '46), Cons. Engr. (Paul A. Uhlmann & Associates), 2901 North High St., Columbus 2, Ohio.

VIVOLI, PIERRE LUIGI (Jun. '46), Ensign, CEC, U.S.N.R.; 93 Palisade Ave., Cliffside Park 6, N.J.

WARDLOW, CARL LEONARD (Jun. '45), 2d Lt., Air Corps, U.S. Army; Box 19, Rossie, Iowa.

WELLS, QUINTON ROLLO (Jun. '45), Ensign, CEC, U.S.N.R., Public Works Office, NAS Lambert Field, St. Louis, Mo.

WOERNER, GELDARD HARRY (Jun. '45) Asst. Civ. Engr, U.S.N., 35th Naval Constr. Battalion, Section 2, N-3002, Care, Fleet Post Office, San Francisco, Calif.

WOLDRIDGE, ALEXANDER JANSSEN (Jun. '45), Ensign, CEC, U.S.N.R., B.O.Q., N.A.S. Lambert Field, St. Louis, Mo.

MEMBERSHIP TRANSFERS

BROSIO, ALFRED LOUIS (Jun. '37; Assoc. M. '46), Industrial and Civ. Engr., Box 206, San Diego 12, Calif.

CEDERGREN, HARRY ROLAND (Jun. '37; Assoc. M. '46), Civ. Engr., U.S. Engr. Dept., 628 Pittock Block (Res., 5310 South East 72), Portland 6, Ore.

DEWEY, HAYWOOD GUION, JR. (Jun. '36; Assoc. M. '45), Capt., Corps of Engrs., U.S. Army, U.S. Waterways Experiment Station, Clinton Sub-office, Box 217, Clinton, Miss.

DOWNEY, SAMUEL BOYD (Assoc. M. '27; M. '45), Structural Designer, Pennsylvania Water & Power Co., 1512 Lexington Bldg. (Res., 3212 Ellerslie Ave.), Baltimore 18, Md.

HAWKER, CLARENCE ROBERT (Jun. '43; Assoc. M. '45), Design Engr., Stevenson & Rubens, Lowman Bldg. (Res., 4445 One Hundred and Sixty-Eighth St. South), Seattle, Wash.

HENNY, ARNOLD LORENTZ (Jun. '30; Assoc. M. '34; M. '46), Engr., U.S. Army Engrs., Pittock Block (Res., 1581 South West Upper Hall St.), Portland 1, Ore.

HILL, HIBBERT MOSSE (Jun. '24; Assoc. M. '30; M. '45), 4512 Wooddale Ave., Minneapolis 10, Minn.

HULME, ARTHUR EDWARD (Jun. '41; Assoc. M. '45), Asst. Hydr. Engr., U.S. Geological Survey, Box N, Cambridge, Nebr.

KARLEN, ROY EDWIN (Jun. '40; Assoc. M. '46), Engr., U.S. Engr. Dept., Federal Bldg. (Res., 1239 Everett Ave.), Louisville, Ky.

KISEVALTER, GEORGE GEORGE (Jun. '31; Assoc. M. '45), Maj., Corps of Engrs., U.S. Army; 1734 Connecticut Ave. N.W., Washington, D.C.

KLAUCK, FREDERICK ROBERT (Jun. '38; Assoc. M. '45), Development Engr., E. I. du Pont de Nemours & Co., Inc., Experimental Station (Res., 107½ Lore Ave.), Wilmington 253, Del.

KREISS, ROBERT FREDERICK (Jun. '33; Assoc. M. '45), Engr. (Hydr.), P-3, U.S. Engr. Office, 1709 Jackson (Res., 1511 South 50th St.), Omaha 6, Nebr.

MCLAUGHLIN, PHILIP LINWOOD (Assoc. M. '30; M. '45), Comdr., CEC, U.S.N.R., Office, Director, Atlantic Div., Bureau of Yards and Docks, Navy Dept., 90 Church St., New York 7, N.Y.

MEADOWS, HENRY EDWARD (Jun. '39; Assoc. M. '45), Asst. Div. Civ. Engr., Humble Oil & Refining Co., Box 1600, Midland, Tex.

MERRYFIELD, FRED (Assoc. M. '34; M. '46), Prof., San. Eng., Oregon State College, Corvallis, Ore.

NEWMARK, NATHAN MORTIMORE (Jun. '34; Assoc. M. '38; M. '45), Research Prof., Civ. Eng., Univ. of Illinois, 111 Talbot Laboratory, Urbana, Ill.

NOYES, GEORGE ALLEN (Jun. '38; Assoc. M. '46), Associate Engr., Hydr., U.S. Engr. Office, Wright Bldg., Sacramento (Res., Route 1, Box 223A, Airport Rd., Nevada City), Calif.

PRUSI, GEORGE ARMAS (Jun. '44; Assoc. M. '45), Lead Engr., Boeing Aircraft Co. (Res., 532 Fourteenth Ave., North), Seattle 2, Wash.

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STANIUNAS, JOHN FRANCIS (Jun. '32; Assoc. M. '45), Comdr., CEC, U.S.N.R., Public Works Dept., Puget Sound Naval Shipyard, Bremerton, Wash.

STREITHOF, CHARLES PERRY (Assoc. M. '37; M. '46), Asst. Chf. Design Engr., Corp. Eng. Office, American Viscose Corp., Philadelphia, Pa. (Res., R.D. 3, Westwood Manor, Wilmington, Del.)

THORSON, ROBERT DEAN (Assoc. M. '37; M. '45), Comdr., CEC, U.S.N.R.; 2286 West 23d St., Los Angeles 7, Calif.

VALLEI, QUINTO (Jun. '41; Assoc. M. '46), Designer and Checker-Engr., Day & Zimmermann, 1324 Widener Bldg., Philadelphia 7, Pa.

WILLIGES, JOHN ANTHONY (Jun. '44; Assoc. M. '45), Cons. Engr. (Hamilton & Williges), 718 Bank of Commerce Bldg., Oakland (Res., 15 Crescent Ave., San Francisco 10), Calif.

REINSTATEMENTS

ATWATER, RALPH WIGHT, Assoc. M., reinstated Jan. 1, 1946.

BARNES, ALFRED EDWARD, Assoc. M., reinstated Jan. 1, 1946.

GADKOWSKI, WALTER, Jun., reinstated Jan. 22, 1946.

MONEY, JOHN MARSHALL, Assoc. M., reinstated Jan. 1, 1946.

TOTAL MEMBERSHIP AS OF FEBRUARY 9, 1946	
Members	6,349
Associate Members	8,109
Corporate Members	14,458
Honorary Members	38
Juniors	6,591
Affiliates	78
Fellows	1
Total	21,166
(February 9, 1945	20,511)

STEERE, MAYNARD JOSEPH, M., readmitted Dec. 21, 1945.

TRIMPI, ALLAN LITTELL, Assoc. M., reinstated Jan. 10, 1946.

WALKWITZ, CLARENCE ARTHUR, Assoc. M., reinstated Jan. 1, 1946.

RESIGNATIONS

BURCHARD, JOHN ELY, M., resigned Jan. 4, 1946.

EDDY, BEN A., M., resigned Jan. 10, 1946.

FENTON, RICHARD, Jun., resigned Jan. 3, 1946.

FOWLER, ARTHUR HOLMES Jun., resigned Jan. 23, 1946.

HEALD, EUGENE HAMILTON, M., resigned Jan. 22, 1946.

JENSEN, MARY ESTHER (MRS.), Jun., resigned Jan. 21, 1946.

KISHEL, EDWARD FRANK, Jun., resigned Jan. 15, 1946.

KORTE, JOSEPH CLARENCE, Assoc. M., resigned Jan. 15, 1946.

MORELAND, JOHN WYLIE, M., resigned Jan. 4, 1946.

NIELSEN, FREDERICK AUSTIN, Assoc. M., resigned Jan. 3, 1946.

OPENSHAW, JOHN EDWARD, Assoc. M., resigned Jan. 15, 1946.

PATTERSON, IRVING WOOSTER, M., resigned Jan. 22, 1946.

SMITH, SYDNEY HUGH, Assoc. M., resigned Jan. 21, 1946.

SOMERS, NEWTON LLOYD, Assoc. M., resigned Jan. 22, 1946.

VESCO, ARTHUR, Jun., resigned Jan. 10, 1946.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

MARCH 1, 1946 NUMBER 3

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every Member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for subprofessional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i.e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

ARNOLD, HUGH MONTGOMERY (Assoc. M.), Barnesville, Ga. (Age 36) (Claims RCA 4.2 RCM 6.4) June 1941 to date with Corps of Engrs., U.S. Army, at present as Col.; since July 1945 Engr., Western Pacific Base Command; previously with U.S. Engr. Dept.

BAGLEY, HARRY HOWE (Assoc. M.), Arlington, Va. (Age 40) (Claims RCA 4.4 RCM 7.3) June 1939 to date with CEC, USNR, being Lt. (jg), Lt., Lt. Comdr. and since Jan. 1944 Comdr.; since May 1943 being Asst. Tech. Planner, Logistics Plans Div., Office of Chf. of Naval Operations, Navy Dept., Washington, D.C.

BALKE, HARRY ALBERT, Pittsburgh, Pa. (Age 42) (Claims RCA 4.0 RCM 11.6) June 1926 to date with American Bridge Co., being Detailer, Squad Engr., and since Jan. 1936 Designer.

BALLAM, HORACE VICTOR, Milwaukee, Wis. (Age 46) (Claims RCA 3.5 RCM 14.6) Jan. 1933 to date Engr. and Supt., The Kramp Constr. Co. of Berlin, Wis.

BAXTER, SAMUEL SERSON (Assoc. M.), Philadelphia, Pa. (Age 40) (Claims RCA 6.6 RCM 7.8) Feb. 1923 to July 1942 and Dec. 1945 to date with City of Philadelphia, from Oct. 1940 to July 1942 and at present Asst. Director, Dept. of Public Works; in the interim with Corps of Engrs., U.S. Army.

BERGER, WALTER BARTON, Suisun City, Calif. (Age 37) (Claims RCM 7.7) June 1944 to date Chf. Deputy County Surveyor, Solano County, Calif.; previously Field Engr., Punnett, Parez & Hutchison, Civ. Engrs.; with Barrett & Hilp, Gen. Contrs.

BRITTON, WILLIAM ROTHROCK (Assoc. M.), Knightstown, Ind. (Age 60) (Claims RCM 32.9) Jan. 1919 to date with State Highway Comm. of Indiana, since Jan. 1925 as Asst. Engr. of Bridge Constr.

BRUNK, GUY GEORGE (Junior), Joliet, Ill. (Age 35) (Claims RCA 2.0 RCM 8.0) Dec. 1942 to date with CEC, USNR, since Nov. 1945 as Lt. Comdr.; previously with John G. Miller, Constr. Co., Waterloo, Iowa; with Rynearson & Koch, Inc., San. Engrs., Waterloo, Iowa.

BRYANT, EDWARD KENDALL, Trenton, N.J. (Age 43) (Claims RCA 2.5 RCM 16.8) June 1942 to date with CEC, USNR, as Lt., and Lt. Commdr., and since Nov. 1945 Commdr.; previously Civ. Engr. (private practice), being Township Engr. for various municipalities in Burlington County, N.J.

CABANISS, WILLIAM FREDERICK EVE, Augusta, Ga. (Age 40) (Claims RCA 4.0 RCM 8.5) Aug. 1942 to Jan. 1946 with CEC, USNR, being Lt., and Lt. Commdr.; previously with PWA as Res. Engr. Inspector, and Senior Constr. Engr.

CAUFIELD, WALLACE BURNSIDE, Peoria, Ill. (Age 54) (Claims RCM 31.7) 1929 to 1934 Engr., and 1945 to date Dist. Representative and Eng. Consultant, Caterpillar Tractor Co.; previously with Kaiser Co., Swan Island Yard Production Eng.; Owner and Operator of Box Manufacturing Plant.

COOK, JAMES RICHARD (Assoc. M.), Caracas, Venezuela. (Age 48) (Claims RCA 12.2 RCM 13.1) Nov. 1943 to date Project Engr. with Cons. Engrs., C. A. Carcas, Venezuela; previously Associate Engr., a Parsons, Brinckerhoff, Hogan & Macdonald New York City; Asst. Chf. San. Engr., Caribbean Archt.-Engr., New York City; Asst. to Chf., Design Sec. for Treatment Plants, Philadelphia, Pa.

DAVES JOEL THOMAS (Assoc. M.), Atlanta, Ga. (Age 47) (Claims RCA 13.1 RCM 6.2) July 1944 to date member of firm, Francis M. Daves & Associates, Atlanta, Ga.; previously Asst. State Highway Locating Engr., and State Highway Paving Engr., Georgia Highway Dept.; Engr., Six Associates, Inc., Asheville, N.C.; Field Engr., J. B. McCrary Inc.; Sales Engr., Culvert Div., Tennessee Coal, Iron & R. R. Co.

DAVIDSON, NORMAN BENTLEY Houston, Tex. (Age 45) (Claims RC 14.5 D 10.6) Jan. 1946 to date with Valco, Inc., Engrs.; previously with Corps of Engrs., U.S. Army being 1st Lt., Major and Lt. Col.; in private practice.

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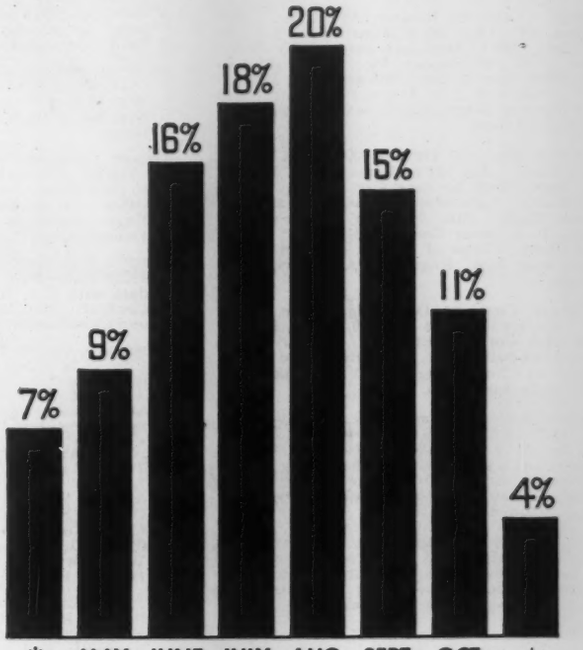

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DODD, JACK GORDON, Norfolk. Va. (Age 44) (Claims RCA 9.3 RCM 10.8) Jan. 1941 to date with CEC, USNR, since Oct. 1945 Public Works Officer, Naval Air Bases, 5th N.D. and Naval Air Station, Norfolk, with rank of Comdr.; previously County Engr., Adams County, Wash.

DOUGLAS, CLARENCE JOSEPH (Assoc. M.), Burlington, Vt. (Age 38) (Claims RCA 4.8 RCM 7.7) Jan. 1946 to date Asst. Prof. of Civ. Eng., Univ. of Vt., Burlington, Vt.; Sept. 1933 to Feb. 1936, Aug. to Oct. 1936 and Nov. 1940 to Nov. 1945 with U.S. Army, since Nov. 1940 with Corps of Engrs., finally as Col.; at present on terminal leave.

ETTLINGER, WILLIAM DEROY (Assoc. M.), New York City. (Age 40) (Claims RCA 3.5 RCM 7.8) Sept. 1945 to date Civ. Engr., United Merchants Laboratories, Inc.; previously Stress Engr., Otis Elevator Co.; Constr. Engr., J. A. Jones Constr. Co.; Engr. (Civ.), War Dept., Corps of Engrs.; Project Engr., Supt., and Dist. Engr., WPA Sewers, Manhattan.

FOX, MARK CHARLES, Oak Ridge, Tenn. (Age 38) (Claims RCA 6.4 RCM 9.1) Oct. 1940 to date with Corps of Engrs., U.S. Army, since Nov. 1943 being Asst. Dist. Engr. and Contr. Officer, at Clinton Eng. Works and (since Nov. 1945) at St. Louis, Mo.

GEBHARD, JOHN CHARLES (Assoc. M.), Washington, D.C. (Age 47) (Claims RCA 14.5 RCM 9.3) Oct. 1921 to date with CEC, U.S. Navy, at present as Capt., since Oct. 1945 being Design Mgr. and Asst. Director of Planning & Design Dept., Bureau of Yards & Docks, Navy Dept., Washington, D.C.

GREEN, FOREST HUBERT, West Lafayette, Ind. (Age 40) (Claims RCA 9.4 RCM 7.3) Feb. 1945 to date Research Engr., Joint Highway Research Project, Purdue Univ.; previously with State Highway Comm. of Indiana.

HUCKINS, JULIAN GREENWAY, Kansas City, Mo. (Age 50) (Claims RCA 13.7 RCM 8.9) March 1941 to date with Corps of Engrs., U.S. Army, since July 1944 at Kansas City, Mo., as Chf., Relocations Branch, Eng. Div.; previously with PRA, Denver, Colo.

HURST, ERNEST GERALD, Hillsboro, Ill. (Claims RCA 4.8 RCM 9.9) April 1937 to date member of firm, Hurst-Rosche, Cons. Engrs., Hillsboro.

KANE, JOHN EDMUND, Peekskill, N.Y. (Age 40) (Claims RCA 4.8 RCM 9.7) Nov. 1945 to date Engr., Standard Brands, Inc., New York City; previously Comdr., CEC, USNR; Asst. to Public Works Officer, with U.S. Navy, Public Works Office, Naval Training Station, Great Lakes, Ill.; Civ. Engr., Office of QM Gen., San. Sec., Constr. Div., War Dept., Washington, D.C.

KLEIN, MICHAEL, New York City. (Age 39) (Claims RCA 5.0 RCM 13.0) 1937 to 1942 Engr., and 1946 Chf. Engr. of Constr., Borough Pres. of Manhattan; in the interim Chf. Engr., War Dept., New York Dist. Engr. Office.

MCDONNAL, WILLIAM JOSEPH, Portland, Ore. (Age 46) (Claims RCA 6.9 RCM 7.9) Sept. 1945 to date Engr. (Civ.) for Corps of Engrs., U.S. Army, Portland, Ore.; previously Supervisor on erection for Kaiser Co., Inc., Portland; Dist. Conservationist, Baker, Ore.; with SCS.

MOYER, RALPH DAVID, Cocoli, Canal Zone. (Age 41) (Claims RCM 11.6) June 1944 to date Chf. Engr., Navy Contr. NOy 9727, Williams Bros. Corporation, Cocoli, C.Z.; previously Chf. Engr., 15th Naval Dist., also Superv. Mech. Engr. (Gen. Mgr.), U.S. Naval Fuel Annex, same Dist.; Associate Structural Engr., Fuel Storage Dept., The Panama Canal, Balboa Heights, Canal Zone.

MURPHY, LINDON JOHN (Assoc. M.), Chicago, Ill. (Age 47) (Claims RCA 8.1 RCM 13.6) April 1944 to date with Staff, Dist. Office III, U.S. Public Health Service, Chicago; previously Regional San. Engr. and Water Security Officer, OCD, Regions VI and VII; Instructor, Asst. Prof., and Associate Prof., Iowa State Coll.

NEHF, ANDREW JAMES, Terre Haute, Ind. (Age 40) (Claims RCA 3.2 RCM 5.0) April 1941 to Sept. 1945 with U.S. Army, finally as Lt. Col.; previously Draftsman and Asst. Engr., TVA.

NORRIS, WALTER THOMAS (Assoc. M.), San Francisco, Calif. (Age 37) (Claims RCA 3.3 RCM 5.2) March to Dec. 1941, March to June 1942 and July 1945 to date Dist. Engr., American Inst. of Steel Constr., New York City; June 1942 to July 1945 Chf. Engr., San Francisco Civil Works Office, Bureau of Yards & Docks, U.S. Navy; Dec. 1941 to March 1942 Chf. Engr., Moore Dry Dock Co., Oakland, Calif.

OLMSTEAD, FRANK ROBERT, Arlington, Va. (Age 41) (Claims RCA 6.0 RCM 8.8) Sept. 1943 to date Senior Soils Specialist, PRA, Div. of Physical Research, Washington, D C ; previously Engr. of Field Testing, and Research Asst., Research Asst. Engr., Michigan Highway Dept.

PAINTER, WILFRED LEWIS (Assoc. M.), San Francisco, Calif. (Age 37) (Claims RCA 5.7 RCM 6.9) Jan. 1941 to Oct. 1945 with CEC, USNR, being Lt., Lt. Comdr., and Comdr.; since Oct. 1945 on terminal leave, employed as Engr. by Pacific Bridge Co., San Francisco, Calif.; previously 2nd Lt., U.S. Marine Corps.

PLAUTZ, EDGAR GOTTLIEB, Milwaukee, Wis. (Age 45) (Claims RCA 7.0 RCM 11.7) June 1925 to date with Wisconsin Highway Comm., Div. No. 2, since May 1934 being Div. Constr. Engr.

QUADE, CHARLES OMAR (Assoc. M.), Dallas, Tex. (Age 38) (Claims RCA 3.2 RCM 6.0) June 1945 to date Head, Eng. Sec., Mil. Constr. Branch, Office, SWD, Dallas; previously with U.S. Engrs., finally as Military Asst. to Dist. Engr., Denison, Tex.

ROSS, LEWIS TENNEY, Washington, D.C. (Age 49) (Claims RCA 7.9 RCM 15.6) Aug. 1918 to date with U.S. Army, at present as Brigadier General; since July 1945 Deputy Commander and Commander, Ft. Belvoir, Va.

ROSSHEIM, DAVID, The M. W. Kellogg Co., Jersey City, N.J. (Age 45) (Claims RCM 16.1) 1930 to date with M. W. Kellogg Co. as Div. Engr., Asst. Chf. Engr., Consulting Engr., Chf. Engr., Mechanical Eng. Dept., and at present Mgr., Special Projects Dept.

ROUSE, HAROLD DOUGLAS (Assoc. M.), Orange, Tex. (Age 40) (Claims RCA 1.9 RCM 7.4) Jan. 1944 to date with E. I. du Pont de Nemours & Co., Wilmington, Del.; previously Asst. Constr. Supt., Gen. Supt., Rio de Janeiro Contr. Co., Miami, Fla.; Prin. Engr. (Civ.) P-6, USED, Trinidad Dist., Port of Spain; with Walsh-Driscoll Constr. Co.; Asst. Civ. Engr., Dept. of Public Works, New York City.

ST. JOHN, LEE HARVEY, Seattle, Wash. (Age 50) (Claims RCM 14.6) Sept. 1943 to date Cons. Engr. (private practice), Seattle, Wash., civil, hydraulic and mining, being United States Mineral Surveyor; previously Civ. Engr. (P-4), U.S. Engrs., War Dept., in Salt Lake, Ogden, and Seattle Dists.; Senior Utility Engr., Smith Hinchman & Grylls, Denver, Colo.; Chf. Engr., Holabird & Root, Archt.-Engr., Chicago, Ill.

SHIRE, ALBERT CHARLES, Washington, D.C. (Age 49) (Claims RCA 12.1 RCM 6.3) Dec. 1942 to date with Foreign Economic Administration, since March 1945 as Chf. Engr.; previously Technical Director, U.S. Housing Authority and Federal Public Housing Authority.

SMITH, EVERETT WILLIAM, Cincinnati, Ohio. (Age 48) (Claims RCA 4.0 RCM 10.7) May 1944 to date Vice-Pres., The Philip Carey Mfg. Co., Lockland, Cincinnati, Ohio; previously with the Johns-Manville Corporation, New York City.

SMITH, FRANK RUSSELL, Omaha, Nebr. (Age 58) (Claims RCA 2.0 RCM 31.5) Dec. 1943 to date with Army Service Forces Engrs.; previously with U.S. Engrs.; Area Engr., SCS, USDA.

SUTHERLAND, EARL CHALMERS, Washington, D.C. (Age 48) (Claims RCA 2.0 RCM 16.5) June 1927 to date with PRA, Div. of Physical Research, Washington, D.C., successively as Jun. Engr., Asst. Highway Engr., Associate Highway Engr., Highway Engr. and (at present) Senior Highway Engr.

TAUL, HORACE WAYNE, West Point, N.Y. (Age 36) (Claims RC 10.7) June 1942 to date with U.S. Army, at U.S. Military Acad., West Point, N.Y., at present as Lt. Col.; previously Sales Engr., P. E. O'Hair & Co., Fresno, Calif.

THAYER, FREDERICK THOMAS, JR., Memphis, Tenn. (Age 35) (Claims RCA 3.0 RCM 6.0) Jan. 1946 to date Engr., U.S. Rubber Co., New York City, in charge of territory covering 4 southern states; previously with U.S. Army, finally as Lt. Col., C.E.

THOMPSON, JOHN CAREY, Troy, N.Y. (Age 42) (Claims RCA 3.9 RCM 14.9) July 1930 to date Asst. San. Engr., and Senior San. Engr., Water Power and Control Comm., Dept. of Conservation, New York State.

TOPPING, CHARLES HINCHMAN (Assoc. M.), Wilmington, Del. (Age 41) (Claims RCA 1.5 RCM 6.8) April 1942 to date with E. I. du Pont de Nemours & Co., being Special Asst., Civ. Engr., Asst. Prin. Archt. & Civ. Engr., and Prin. Archt., & Civ. Engr.; previously Project Engr. and (later) Executive Asst., Lockwood & Andrews, Cons. Engrs.

WARREN, FREDERICK HAYES (Junior), Washington, D.C. (Age 35) (Claims RCA 2.3 RCM 6.9) July 1942 to date with U.S. Army as 1st Lt., Capt., Major, Lt. Col. and at present Col., Transportation Corps, Executive Officer and Dept. Port Comdr., Los Angeles Port Embarkation; previously Chf. Eng. Coordinator, Constr. Div., OQMG, Washington, D.C.; with RFC.

WOJDYGO, JOSEPH MORTIMER (Assoc. M.), Mt. Prospect, Ill. (Age 38) (Claims RCA 10.0 RCM 10.5) June 1938 to Jan. 1941 Jun. and Asst. Civ. Engr., and Sept. 1945 to date Asst. Civ. Engr., San. Dist. of Chicago; in the interim with U.S. Army, finally commanding an observation battalion.

APPLYING FOR ASSOCIATE MEMBER

ALEXANDER, GEORGE WILKINS (Junior), Wilmington, Del. (Age 35) (Claims RCA 3.4) Dec. 1940 to date with Dravo Corporation of Wilmington, Del., since May 1945 as Co-Supt. of shipyard.

ANDERSEN MADS CLARENCE (Junior), New Orleans, La. (Age 28) (Claims RCA 2.3) June 1944 to Dec. 1945 with CEC, USNR as Ensign; previously with Austin Bridge Co. and Austin Road Co. finally as Estimator; Asst. Engr., Bartlett, Norris, Coltharp, and Miller; Jun. Engr., U.S. Dept. of State.

AYER, GORDON ROUNDY, Ithaca, N.Y. (Age 35) (Claims RCA 2.0) Aug. 1941 to date Jun. Hydr. Engr. and Asst. Hydr. Engr., U.S. Geological Survey, Dept. of Interior, Albany, N.Y.

BANKS, HAROLD ELTON, Lakewood, Ohio. (Age 43) (Claims RCA 4.5) Oct. 1945 to date Engr., The McDowell Co., Cleveland, Ohio, being Civ. Engr., Job Supt., and Estimator; previously with Hunkin-Conkey Constr. Co., Cleveland, Ohio.

BERRY, WILLIAM LITTEL, Huntington Beach, Calif. (Age 39) (Claims RCA 10.2 RCM 1.8) April 1938 to June 1941 and Sept. 1945 to date Asst. Hydr. Engr., Div. of Water Resources, California Dept. of Public Works; in the interim with U.S. Army; Surveyman and Inspector, Los Angeles Dist., USED.

BRUNN, GUSTAV A., Kansas City, Mo. (Age 40) (Claims RCA 7.5) 1945 to date Mech. Design Engr., Standard Oil Corporation of Indiana; previously Equipment Engr., Pratt & Whitney Aircraft Corporation; Traffic Engr., Kansas City Public Service Co.

CARUSO, JOSEPH JOHN, Roslindale, Mass. (Age 30) (Claims RCA 7.3) Nov. 1940 to date Structural Designer and Draftsman, U.S. Navy Yard, Boston, Mass.

CHING-KAI, LOH, Denver, Colo. (Age 32) (Claims RCA 1.5) April 1939 to date with National Resources Comm. of China as Asst. Engr. and Associate Engr.; at present Trainee with U.S. Bureau of Reclamation, sent by Chinese Govt.

CLARK, EDWARD SHANNON, Schoharie, N.Y. (Age 43) (Claims RCA 16.6) Oct. 1945 to date private practice of surveying; previously Land Surveyor with J. Spencer Howard, Baltimore, Md.; Land Surveyor, Otsego County and Schoharie County Highway Dept.

CODD, ASHTON RUTHERFORD, Sacramento, Calif. (Age 45) (Claims RCA 5.7 RCM 12.1) Oct. 1944 to date Associate Hydrologic Engr., Central Sierra Snow Investigation Laboratory; previously with U.S. Weather Bureau as Asst. Hydrologic Engr. and Associate Engr.

CRAWFORD, RAYMOND ROPER (Junior), Fairfax, Calif. (Age 34) (Claims RCA 5.3) Jan 1944 to date Field Engr., Marineship Corporation; previously Asst. Structural Engr., TVA; Jun. Civ. Engr., U.S. Dept. of Agriculture, SCS; Chainman and Asst. Civ. Engr., Richfield Oil Corporation.

CRUMPACKER, HAROLD CHESTER (Junior), Indianapolis, Ind. (Age 34) (Claims RCA 3.9) Oct. 1941 to date with Indiana Highway Comm., finally as Squad Chief, Road Dept.; previously Jun. Engr. (Grade P-1), Topographic Branch, Geological Survey, U.S. Dept. of Interior.

CUSHING, JEROME JAMES (Junior), Chicago, Ill. (Age 32) (Claims RCA 3.8) March 1937 to date with Great Lakes Dredge & Dock Co., being Field Engr., Estimating Engr., Chf. Field Engr. and since Nov. 1945 Estimating Engr., Administration Div.

DEWANTE, RANDOLPH HOQUE (Junior), Sacramento, Calif. (Age 27) (Claims RCA 1.8 RCM 0.1) Sept. 1942 to date 1st Lt., San. Corps, U.S. Army; previously with U.S. Engrs., in various capacities, finally as Associate Engr.

DONNAN, WILLIAM WALTER (Junior), Imperial, Calif. (Age 34) (Claims RCA 4.8) Aug. 1934 to date with U.S. Dept. of Agriculture, finally as Associate Civ. Engr., Div. of Irrigation.

DORNEMANN, FREDERICK HENRY (Junior), Augusta, Ga. (Age 35) (Claims RCA 11.6) At present Designer, Chas. T. Main, Inc., Engrs. of Boston, Mass.; Feb. 1943 to 1946 with U.S.N.R.; previously with The Panama Canal Special Eng. Div. finally as Associate Structural Engr.

EICHENBAUM, LEOPOLD, Brooklyn, N.Y. (Age 32) (Claims RCA 3.9 RCM 2.2) April 1942 to

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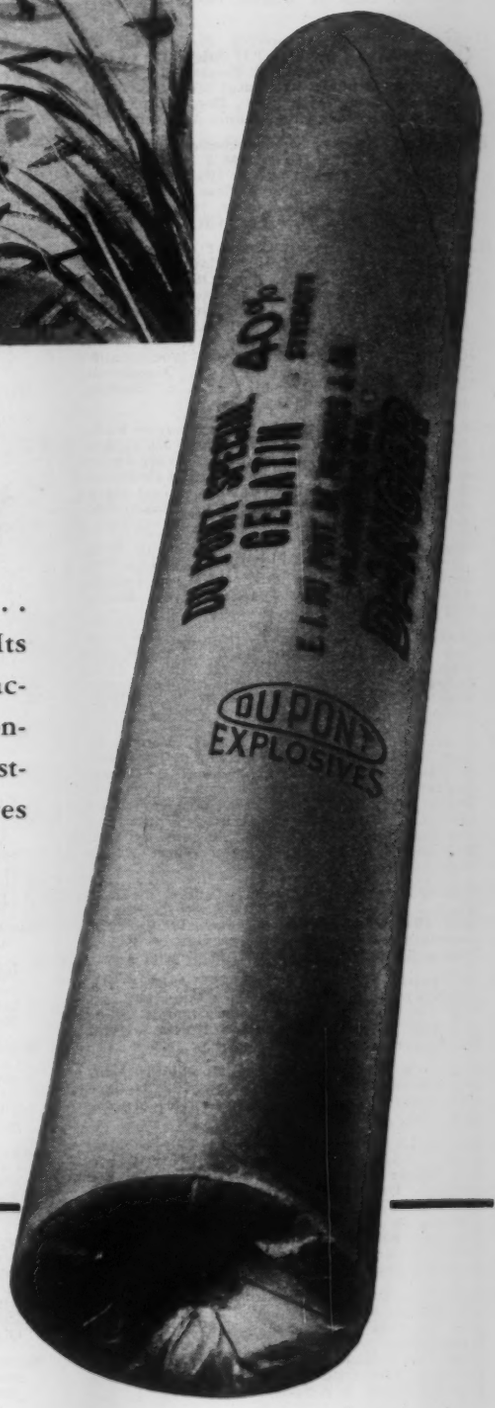

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date with U.S. Navy (Seabees), being Constr. Officer, and Officer in Charge of construction; previously on construction of Jamaica, N.Y., sewage-treatment works.

FLEMING, JAMES ALOYSIUS, JR. (Junior), White Plains, N.Y. (Age 34) (Claims RCA 4.4 RCM 4.5) July 1942 to date with Corps of Engrs., U.S. Army, being Asst. Post Engr., and Post Engr.; previously with New York City Board of Water Supply; with WPA.

GILFETHER, CYRIL ROBERT, Piedmont, Calif. (Age 39) (Claims RCA 9.5 RCM 2.6) July 1943 to date with A. J. McCosker Gen. Contr., Berkeley, Calif.; previously with Piombo Bros. & Co., Engrs. and Contrs., San Francisco, Calif.

GOHDE, CHARLES HENRY, Evanston, Ill. (Age 32) (Claims RCA 5.4) June 1942 to date with Corps of Engrs., since April 1943 as Capt., being Post San. Engr., San. Corps, AAF, Flying Training Command; previously Plant Civ. Engr., southwest sewage-treatment plant; Chicago.

GONZALEZ MENA, PEDRO, Santurce, Puerto Rico. (Age 34) (Claims RCA 2.3) Jan. 1943 to date with Govt. of Puerto Rico, San Juan, finally as Asst. Designing Engr.; previously Structural Designer, U.S. Naval Base, San Juan; Designing Engr., Dept. of Interior, Puerto Rico, Div. of Highways.

GREENSPAN, NOAH, Brooklyn, N.Y. (Age 34) (Claims RCA 4.8 RCM 3.1) Aug. 1941 to date Army Officer, Corps of Engrs., at present Major; previously Structural Steel Draftsman and Eng. Asst., with Pres., Borough of Manhattan, New York City Tunnel Authority.

HALL, JOHN HENRY, New Rochelle, N.Y. (Age 52) (Claims RCA 16.5 RCM 7.1) At present inactive; Jan. 1943 to Nov. 1945 Lt. Comdr., CEC, U.S. Navy, being Officer in Charge of Constr.; previously Constr. Supt., Tobias Heller & Co., Inc., New York City.

HALL, MELVIN HENRIC CLEMET (Junior), San Lorenzo, Calif. (Age 35) (Claims RCA 7.4 RCM 0.9) Aug. 1945 to date Office Engr., being Asst. to Dean Hammond, Henry J. Kaiser Co., Emeryville, Calif., on Hammond airplane; previously Civ. Engr., Donald R. Warren Co., San Francisco, Calif.; Senior Engr., Mech. Eng. Dept., Kaiser Engrs., Oakland, Calif.; Asst. Office Engr., Berry Eng. Co., Bremerton, Wash.; with Boeing Aircraft Co., Seattle, Wash.; with Dept. of Interior.

JAROS, STANLEY FRANCIS (Junior), Chagrin Falls, Ohio. (Age 34) (Claims RCA 2.7 RCM 8.8) June 1941 to Sept. 1945 with U.S. Army finally as Staff Officer (Operations S-3), 61st Ordnance Group, Okinawa, at present on terminal leave; previously Gas Engr., Servel, Inc., Evansville, Ind.

JENSEN, MYRON ORVAL (Junior), Murphy, N.C. (Age 35) (Claims RCA 9.2) Sept. 1934 to date with Hydraulic Data Div., TVA, in various capacities, since July 1945 as Hydr. Engr., Murphy, N.C.

KENNEDY, JOSEPH MICHAEL (Junior), New York City. (Age 31) (Claims RCA 4.7 RCM 2.3) March 1941 to date with North Atlantic Div., Corps of Engrs., since March 1945 as Senior Engr. (Civ.); previously with U.S. Engr. Office as Eng. Draftsman and Jun. Engr. (Civ.).

KLINDT, PEDRO (Junior), Caracas, Venezuela. (Age 32) (Claims RCA 4.0 RCM 2.6) June 1943 to date with Instituto Nacional de Obras Sanitarias, being Chf. Engr. of Technical Depts., Asst. and Acting Pres., and since May 1945 Chf. Engr. of the Water Works and Sewerage Dept. of Caracas; previously Chf. Engr., and Design Engr. of the Water Works Dept., Caracas.

KRAMER, HARRISON WALLACE (Junior), Seattle, Wash. (Age 31) (Claims RCA 5.0 RCM 1.4) Sept. 1944 to date Partner, James W. Carey & Associates, Cons. Engrs.; previously Engr., Boeing Aircraft Co.; with H. D. Fowler Co.

LAST, IRVING (Junior), Bronx, N.Y. (Age 34), (Claims RCA 11.7) Aug. 1938 to Aug. 1942 and Nov. 1945 to date Civ. Eng. Draftsman, Office of Borough Pres. of Manhattan; in the interim Draftsman, Tec. 4, U.S. Army.

LAUGENOUR, KENNETH CLARK, Woodland, Calif. (Age 50) (Claims RCA 12.6) Sept. 1921 to date with Sutter Basin Co. (Sutter Basin Corporation, Ltd.).

LEOPOLD, LUNA BERGERE (Junior), Los Angeles, Calif. (Age 30) (Claims RCA 3.9) July 1944 to date Officer in Charge, Army Research Weather Station, Univ. of California, being Capt., Army Air Corps; previously student and Instructor in Meteorology, Univ. of California; Associate Engr., U.S. Engr. Office, Los Angeles, Calif.; with U.S. Dept. of Agriculture, finally as Associate Hydrologic Engr., SCS.

LYONS, IVOR ARTHUR, London, England. (Age 34) (Claims RCA 6.2 RCM 4.5) June 1945 to date Sewerage Engr., Singapore; previously Hydr. Engr., D. Warren Co., Los Angeles, Calif.; on technical staff of Bechtel, McCone & Parsons, Los Angeles; Asst. Hydr. Engr., Kistner, Curtis & Wright, Los Angeles.

MCCORMMACH, ALBERT LESLIE, Portland, Ore. (Age 39) (Claims RCA 2.0) Sept. 1942 to date with War Dept., U.S. Engrs., at Portland, Ore., since Sept. 1945 as Associate Engr. (Hydr.); previously with Bonneville Power Administration.

MCCUTCHEN, ALBERT CARROLL, Rolla, Mo. (Age 33) (Claims RCA 6.5 RCM 4.3) March 1931 to June 1937 and Aug. 1938 to date with U.S. Geological Survey, since June 1944 as Associate Topographic Engr., Div. Office; in the interim Engr., Seismic Explorations, Inc., Houston, Tex.

MCILVAINE, WILLIAM DUFFIELD, JR., Chicago, Ill. (Age 39) (Claims RCA 10.2 RCM 0.6) July 1945 to date Asst. Director, American Public Works Association; previously with Minneapolis-St. Paul San. Dist., as Draftsman, Elec. Engr., Asst. Engr. and Mech. Engr.

MCLEROY, JOHN OTTO, JR. (Junior), Dallas, Tex. (Age 29) (Claims RCA 3.3) June 1938–Jan. 1942 and Feb. 1944 to date with Austin Bridge Co., since Feb. 1945 as Equipment Engr., Dallas, Tex.; in the interim with Corps of Engrs., U.S. Army, assigned to Aviation Engrs.

MESEKE, VICTOR HAROLD, Alta Vista, Kans. (Age 40) (Claims RCA 1.9 RCM 7.4) Sept. 1940 to date with U.S. Army, with Q.M. Corps and (after Dec. 1941) Corps of Engrs., various ranks, since Jan. 1946 as Col.; since April 1945 Res. Engr. for construction of Headquarters facilities for Continental Air Forces, Andrews Field, Washington, D.C.

MOELLER, HERBERT IRA, Montgomery, Ala. (Age 34) (Claims RCA 6.1 RCM 2.1) Oct. 1942 to date with Algernon Blair, Contr., since Jan. 1945 as Asst. Chf. Structural Engr.; previously Engr. and Estimator, Sullivan, Long & Hagerty & Algernon Blair, Contrs.; with Alabama Highway Dept.

MOWRY, GEORGE ALBERT, JR., Gamboa, Canal Zone. (Age 31) (Claims RCA 3.3 RCM 3.8) 1941 to 1943 with Bldg. Div., and 1944 to date with Dredging Div., The Panama Canal; in the interim Foreman and Engr., FWA, PRA; previously with Okes Constr. Co., St. Paul, Minn.

NEWHALL, GEORGE NELSON (Junior), Berkeley, Calif. (Age 35) (Claims RCA 10.7) March 1941 to Sept. 1945 with CEC, USNR, finally as Lt.-Comdr.; previously Asst. Highway Engr., U.S. Forest Service, California Region.

NICHOLS, DON LEE (Junior), Mandan, N.D. (Age 35) (Claims RCA 2.9 RCM 2.0) March 1941 to date with Corps of Engrs., U.S. Army, since Dec. 1943 Staff Officer with 1321st Engrs. in training and maneuvers with 7th Army in France, with 10th Army at Okinawa; previously Highway Designer and Draftsman, North Dakota Highway Dept.

NICHOLS, VLADIMIR NICHOLAS, Elmhurst, N.Y. (Age 37) (Claims RCA 5.2) 1945 to date Asst. Chf. Engr., George W. Rogers Constr. Corporation, New York City; previously Structural Designer with Madigan-Hyland, Cons. Engrs., Long Island City, N.Y., and Bethlehem Steel Co., New York City.

NOVAK, LEO CHARLES (Junior), Boulder, Colo. (Age 34) (Claims RCA 4.8 RCM 2.5) Sept. 1938 to June 1941 Instructor in Civ. Eng., and at present Asst. Prof., Dept. of Civ. Eng., Univ. of Colorado; in the interim with U.S. Army.

OLMSTEAD, CARLOS BOYES (Junior), Mission, Kans. (Age 32) (Claims RCA 3.3) Aug. 1940 to date with U.S. Engr. Dept., Kansas City Mo., Dist., since Sept. 1944 as Associate Engr.; previously with Utah Highway Comm.

REHM, LEO FRANK (Junior) Milwaukee, Wis. (Age 30) (Claims RCA 5.0 RCM 0.7) July 1943 to Jan. 1946 Lt., U.S. Army, as Sanitary Engr., at present on terminal leave; previously Asst. Engr., U.S. Dept. of Agriculture; with Consoer, Townsend & Quinlan, Chicago, Ill.

SARAYLIOGLU, YANI (Junior), Detroit, Mich. (Age 29) (Claims RCA 2.0) June 1941 to date Structural Designing Engr., Giffels & Vallet, Inc., L. Rosseti, Associated Engrs. & Archts., Detroit; previously with J. L. Peters, Steel, Constr. Co., Dearborn; with Ayres, Lewis, Norris & May, Engrs., Ann Arbor.

SCHNEIDER, WARREN ARTHUR, Los Angeles, Calif. (Age 46) (Claims RCA 19.4) Jan. 1926 to date with Dept. of Public Works, Los Angeles, Calif., since Feb. 1941 as Engr. in Charge of Disposal of Wastes, Bureau of Maintenance and Sanitation.

SELIGMANN, IRVING SIDNEY, San Antonio, Tex. (Age 32) (Claims RCA 5.4) Nov. 1945 to date with H. R. F. Helland, Cons. Engr., San Antonio, Tex.; previously with U.S. Navy; with Texas Highway Dept.

SEWELL, JAMES ARTHUR (Junior), Newport, Wash. (Age 29) (Claims RCA 1.7 RCM 0.3) Sept. 1945 to date associated with H. A. Sewell in consulting engineering practice; previously with Everett-Pacific Shipbuilding and Drydock Co.; with Washington Highway Dept., Olympia.

SHEEHAN, WILLIAM MICHAEL (Junior), Richmond Hill, N.Y. (Age 28) (Claims RCA 4.7) June 1938 to Nov. 1942 and Nov. 1945 to date with Poirier & McLane Corporation, since Nov. 1945 as Constr. Engr.; in the interim with CEC, USNR, being Lt. (jg), and Lt.

SHJEFLO, JELMER BURTON (Junior), Youngstown, Ohio. (Age 35) (Claims RCA 3.4) April 1939 to date with U.S. Dept. of Interior, in various capacities, since Sept. 1942 as Asst. Hydr. Engr.

STOCK, ELDON MARK (Junior), Logan, Utah. (Age 36) (Claims RCA 4.1 RCM 1.9) Oct. 1935 to June 1940 Instructor, and July to Sept. 1940 and Oct. 1945 to date Asst. Prof., Eng. School, Utah State Agri. Coll.; Sept. 1940 to Feb. 1946 Capt. and Major, Coast Artillery (Antiaircraft) Service Command and Infantry, U.S. Army, after Oct. 1945 on terminal leave.

STONEBURNER, CLIFTON GODFREY (Junior) Arlington, Va. (Age 33) (Claims RCA 3.8 RCM 6.3) Nov. 1945 to date Highway Engr., Dept. of Public Service, Arlington; previously Traffic Engr. and Asst. Engr., Arlington County Eng. Dept.

TANNER, ALVA RICHARD, Sacramento, Calif. (Age 36) (Claims RCA 1.6) May 1941 to date with Branch of Project Planning, U.S. Bureau of Reclamation, Central Valley Project, Calif., since Aug. 1944 Engr. (Hydr.); previously Jun. Engr., International Boundary Comm. U.S. and Mexico, Las Cruces, N.Mex.

WALKER, HARLEY REGINALD (Junior), Houston, Tex. (Age 30) (Claims RCA 3.3 RCM 3.0) Sept. 1939 to date Engr., Mosher Steel Co., Houston, Tex.

WALKER, MURRAY GRAHAM, Olympia, Wash. (Age 31) (Claims RCA 3.3) Nov. 1944 to date Engr., Washington Div. of Hydraulics, Olympia; previously Asst. Naval Archt. (Intermediate), Puget Sound Bridge & Dredging Co.; Jun. Naval Archt., Navy Dept., Mare Island, Calif.; Civ. Eng. Draftsman, Bureau of Reclamation.

WILD, HARRY EDWARD (Junior), Daytona Beach, Fla. (Age 31) (Claims RCA 3.8 RCM 3.7) Oct. 1944 to date Chf. Engr., Russell & Axon, Cons. Engrs., Inc.; previously with U.S. Engr. Office, being Inspector, Jun. Engr., and (after July 1941) Asst. Head and Head, Water Supply and Sewage Sec., Eng. Div., Jacksonville, Fla.

WITBECK, HORACE MALCOLM (Junior), Fort Belvoir, Va. (Age 34) (Claims RCA 3.1) July 1938 to date with Corps of Engrs. U.S. Army, at present as Lt. Col., being Director of Military Training at Ft. Belvoir.

WOODS, SAMUEL ERNEST, JR., Wilmington, Calif. (Age 33) (Claims RCA 2.5 RCM 3.3) Dec. 1945 to date Design Engr., Southern California Gas Co., Los Angeles, Calif.; previously Asst. to Chf., Planning Div., Engr. Office, HAF Mid-Pacific; Chf., Fuel Storage Sec., Eng. Design Div., U.S. Engr. Office, Honolulu, Hawaii; Design Engr., Memphis (Tenn.) Light & Water Div.

WRIGHT, PURD B., JR., New York City. (Age 45) (Claims RCA 10.9 RCM 12.9) Feb. 1936 to date with Lone Star Cement Corporation as Div. Engr., and since April 1942 Mgr. *Incor* and Technical Service.

APPLYING FOR JUNIOR

COGNETTA, JOHN ANTHONY, Bridgeport, Conn. (Age 27) (Claims RCA 4.0) Nov. 1945 to date Stress Analyst, Grumman Aircraft Eng. Corporation, Bethpage, N.Y.; previously Aircraft Eng. Officer, U.S. Army Air Corps; Army Ordnance Inspector, Hartford Ordnance Dist., Springfield, Mass.

CRAIG, FRANK SMITH, Dallas, Tex. (Age 23) June to Oct. 1944 and Feb. to July 1945 with J. G. Rollins; previously with Pennsylvania Shipyards as Draftsman and Loftsman.

FEINGOLD, RICHARD MONROE, Brookline, Mass. (Age 23) Aug. 1944 to date Jun. Engr., Jackson & Moreland, Engrs., Boston, Mass.; previously Structural Engr., Curtiss-Wright Corporation, Airplane Div., Louisville, Ky.

GAMBRELL, RODERICK DHU, JR., Houston, Tex. (Age 22) Nov. 1945 to date Jun. Chemist, Public Works Dept. Houston; previously with U.S. Army, finally as Capt., FAR.

HARPER, SAMUEL DELANO, Florence, S.C. (Age 25) Oct. 1945 to date Jun. Structural Engr., W. D. Harper & Co., Archts., Florence, S.C.; previously with Corps of Engrs., U.S. Army; with TVA.

LOK-HUNG, FUNG, Denver, Colo. (Age 31) (Claims RCA 2.1) June 1945 to date studying dam design with U.S. Bureau of Reclamation (sent by Chinese Govt.); previously with National Resources Comm., China, finally as Assoc. Engr.

PITTMAN, JAMES OLLIN, JR., Bremerton, Wash. (Age 31) Oct. 1941 to date with Public Works Design Sec., Puget Sound Navy Yard, Bremerton Wash., at present as Civ. Engr. (P-4); previously with Mid-Continent Petroleum Corporation, Tulsa, Okla.

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RABOLD, RICHARD CLAIR, Altoona, Pa. (Age 25) 1944 to date with U.S Navy, Jan. 1943 to Sept. 1944 Stress Analyst, Douglas Aircraft Co., Inc.

RAY, GORDON KEITH, Mundelein, Ill. (Age 26) Dec. 1945 to date Engr., Portland Cement Association; previously Capt., Corps of Engrs., U.S. Army; Jun. Engr., Illinois Div. of Highways.

RINK, RUSSELL WILLIAM, Coronado, Calif. (Age 31) (Claims RCA 2.5) Oct. 1944 to date Asst. to City Mgr., San Diego, Calif.; previously City Mgr., Building Inspector, and Asst. to City Engr., Coronado.

TIBERY, ANGELO JOSEPH, Pittsburgh, Pa. (Age 28) (Claims RCA 0.2) Dec. 1945 to date Structural Designer, Rust Eng. Co., Pittsburgh; previously Seaman 1st Class, USNR; Reinforced Concrete Designer & Detailer, Carnegie Illinois Steel Corporation, Pittsburgh; Transitman, Computer & Draftsman with Benjamin H. Aires, Civ. Engr. & Surveyor, Pittsburgh.

1941 GRADUATE

VA. MIL. INST.
(B.S. in C.E.)

	Age
STRUDWICK, FRED NASH, JR.	(25)

1942 GRADUATE

UNIV. OF WASH.
(B.S. in C.E.)

RAFFELSON, RAY MELVIN	(26)

1944 GRADUATE

RUTGERS UNIV.
(B.S. in C.E.)

DERN, HERBERT	(20)

1945 GRADUATES

UNIV. OF COLO.
(B.S. in C.E.)

LOOPER, JOSEPH HENRY	(20)

COLUMBIA UNIV.
(B.S.)

SCANLON, WILLIAM MICHAEL	(20)

CORNELL UNIV.
(B.C.E.)

DAVIS, FROHMAN PAUL	(21)

LEHIGH UNIV.
(B.S. in C.E.)

LAURENCOT, RENE EDWARD	(20)

UNIV. OF N. MEX.
(B.S. in C.E.)

GAFFORD, WILLIAM ROGERS	(21)
ORCUTT, RICHARD GATTON	(22)

COLL. OF CITY OF N.Y.
(B.C.E.)

KAHN, ELLIOTT HERBERT	(20)

N.Y. UNIV.
(B.C.E.)

ABONYI, ERWIN	(23)

UNIV. OF OKLA.
(B.S. in C.E.)

COE, JACK JACOBY	(22)
COLE, MARVIN LYNN	(20)

TULANE UNIV.
(B.E. in C.E.)

WHITMAN, ANDREW PETER PAUL, JR.	(20)

VANDERBILT UNIV.
(B.E.)

WAGGONER, WILLIAM LAWRENCE	(20)

1946 GRADUATES

UNIV. OF DELAWARE
(B.C.E.)

LEWIS, ABRAHAM BARTON	(20)
JOHNSTON, ELWOOD RUSSELL, JR.	(20)

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

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Elimination of individually fired furnaces *can* *do more* than any other one thing to solve the smoke problem on a city-wide basis!

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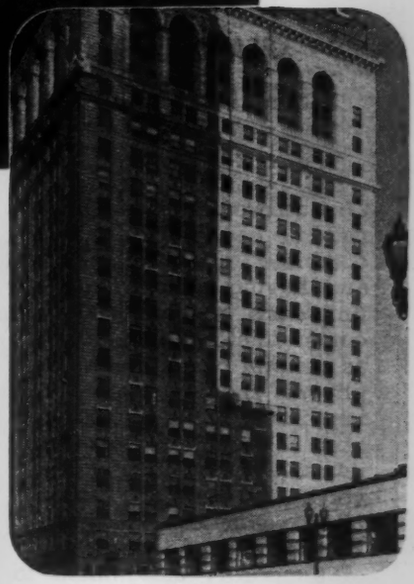
Central Heating, universally applied, should be a first consideration in communities which are earnestly seeking the best weapon to fight the smoke menace. Large, modern steam plants, equipped with the latest automatic devices for efficient fuel combustion and serving large districts, will practically eliminate the clouds of smoke now hanging over our cities, which come from the thousands of individual chimneys. Modern methods of steam distribution—piping steam safely at any desired high pressure, now make Central Heating practical for any application—be it an entire city, an industrial or commercial area, a large housing project or a small real estate development.

Ric-wil has many case histories and project studies on Central Heating in its files. If smoke abatement is YOUR problem, we can help you.



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A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription of $3 per quarter or $10 per annum, payable in advance.

MEN AVAILABLE

CIVIL ENGINEER; M. ASCE; graduate of Massachusetts Institute of Technology; age 43; 20 years' experience in construction, equipment installation, plant operation and maintenance. Capable executive, with experience in design and construction of sewage-disposal plant; seek permanent position with engineering or construction firm. Location immaterial. Available immediately. Last 5 years with CEC, U.S. Navy. C-227.

CIVIL ENGINEER; Jun. ASCE; B.E. in C.E., Tulane University, 1940; age 28; single; licensed C.E. in Louisiana; available about March; 3½ years as engineer officer on destroyers; 1 year as junior structural engineer with Corps of Engineers; 1 year with oil companies. Desire work in structural and construction field. Will consider foreign service. C-228.

CONSTRUCTION MANAGER; M. ASCE; 35 years' experience on industrial construction with national companies. Large following of good construction men. Familiar with Eastern market, architects, and contractors. Graduate C.E. Now employed, but available in one month. Minimum salary $8,500. C-229.

SANITARY ENGINEER; Jun. ASCE; graduate of Pennsylvania State College, 1942; age 24; discharged veteran; desire to specialize in the design, construction, and operation of sewerage systems and sewage-disposal plants. Willing to work in field or office, and to travel; available immediately. C-230.

HYDROELECTRIC ENGINEER; M. ASCE; 44; married; no children; graduate civil engineer, with 23 years' experience—14 on supervision and management of design for complete projects of heavy construction hydroelectric power plants, and 3 years in managing of design and construction of chemical process plants. Willing to go abroad. At present employed, but available on short notice. C-231.

EXECUTIVE; M. ASCE; graduate civil engineer; licensed professional engineer, New York and Kansas; over 12 years' executive and administrative service in United States Army, including 2 years on defense projects in Construction Division; 12 years' industrial construction with large electrical manufacturing corporation. Available May 1; location immaterial. C-232.

MATERIALS ENGINEER; Assoc. M. ASCE; civil graduate; married; 39; 15 years' experience in procurement, specifying, scheduling, inspecting, and erection of materials and equipment for chemical industry. Familiar with reports and costs. Executive and organizational ability. Desire permanent work, preferably purchasing for process industry. Available February 20, 1946. C-233.

BRIDGE AND STRUCTURAL ENGINEER; Assoc. M. ASCE; 35; married; one child; B.S. and M.S. degrees; major in structural engineering; 2 years' general field experience; 1 year on steel detailing and design, 6 years as designing engineer (principally bridges); Lt. Colonel, U.S. Army, now on terminal leave; member A.C.I., professional license; desire permanent connection in engineering or related fields. Available immediately. C-234.

SALES AND PRODUCTION ENGINEER; Assoc. M. ASCE; Army officer on terminal leave; former sales manager for manufacturer of building materials. Graduate engineer with proved sales record. Best of references and will consider any location, if there is opportunity there. C-235.

ARMY CAPTAIN, SANITARY CORPS; Assoc. M. ASCE; age 41; M.S. in sanitary engineering; 13 years' experience in operation of water and sewage plants; 3 years in Army sanitation; desire position in operation, public health, or with manufacturer of water and sewage works equipment. Expect discharge in May 1946. C-236.

EXECUTIVE ENGINEER; Jun. ASCE; Commander, Civil Engineer Corps, USNR, on terminal leave; age 35; commanded Seabee Battalions, Atlantic and Pacific areas. Licensed professional engineer; technical college graduate; 17 years' training and experience. Organization and supervision of design, construction, and maintenance personnel on large-scale projects, such as airports, hospitals, operating bases, housing development, bridges, and industrial plants. C-237.

CIVIL ENGINEER: Jun. ASCE; young; graduate; would like opportunity to learn engineering economics and managerial work; 2 years' experience general office engineering. Now studying law by correspondence and will receive LL.B. in approximately 18 months. Married; no children. Prefer Southern location. C-238.

CIVIL ENGINEER; Assoc. M. ASCE; French licensed engineer; 5 years' experience in America; 18 years in Europe (engineering and contracting); going for a business trip to the States in March; desire connection with American firm interested in European business. C-239.

CIVIL ENGINEER; Jun. ASCE; graduate; 28; married; 27 months as construction foreman on construction and maintenance of service stations, warehouses, tanks, pipe lines; 4 years on public works and plant maintenance, U. S. Navy (released as Lt. Comdr.); desire permanent position in northern New Jersey or New York City, as draftsman-estimator plus field work with sanitary consultant, contractor, or municipality. C-240.

ASSISTANT TO FIELD SUPERVISOR ON CONSTRUCTION; age 22; married. Have held part-time jobs while a student; graduated from University of Southern California, June 1945, with a B.E. degree in civil engineering. Location preferred, southern California, but will consider elsewhere. C-241.

CIVIL ENGINEER; Jun. ASCE; 21; single; B.C.E., Manhattan College, structural option; 2nd Lieutenant, U.S.M.C.R., attached to Engr. Bn.; 8 months' field experience; also 8 months' summer experience on field construction and surveying. Desire position near New York City with construction firm as field engineer. Expect discharge approximately May 1, 1946. C-242.

CIVIL ENGINEER; Assoc. M. ASCE; 38; civil and structural graduate; registered professional engineer; 16 years' experience, principally in construction, covering wide field of heavy construction including mass excavation and demolition; highway location and construction; industrial plant construction; dams, tunnels, harbor, and waterways construction. Naval office in Civil Engineer Corps for 3 years. Salary, $6,000. C-243.

CIVIL ENGINEER; Jun. ASCE; 32; married; graduate; registered professional engineer, Indiana and Ohio; 8 years' varied experienced in design and construction of water works, sewage disposal plants, highways, and reinforced concrete buildings. Desire connection with consulting engineering firm or construction engineering department of large manufacturing concern. Mid-West location preferred. C-245.

WANTED ESTIMATORS

•

One or two experienced estimators, capable of making complete quantity surveys and having a knowledge of unit costs on industrial and commercial buildings as well as general construction. Applicants should be generally familiar with building service costs as well as structural items. The position will involve responsibility for contract estimates. Location, Boston, Mass., with possibility of temporary assignment to field offices. Applications, accompanied by photograph, complete statement of training, experience and salary expected, should be addressed to Stone & Webster Engineering Corporation, 49 Federal Street, Boston, Mass. Interviews will be arranged either at New York or Boston for qualified applicants.

WANTED

Civil Engineer, Architect or equivalent experience, capable of practical application and original thinking for research on building material uses in Research and Development Department of progressive expanding organization, producing building materials. New York Metropolitan area.

Send résumé to

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STEVENS WATER LEVEL RECORDER *Type F*

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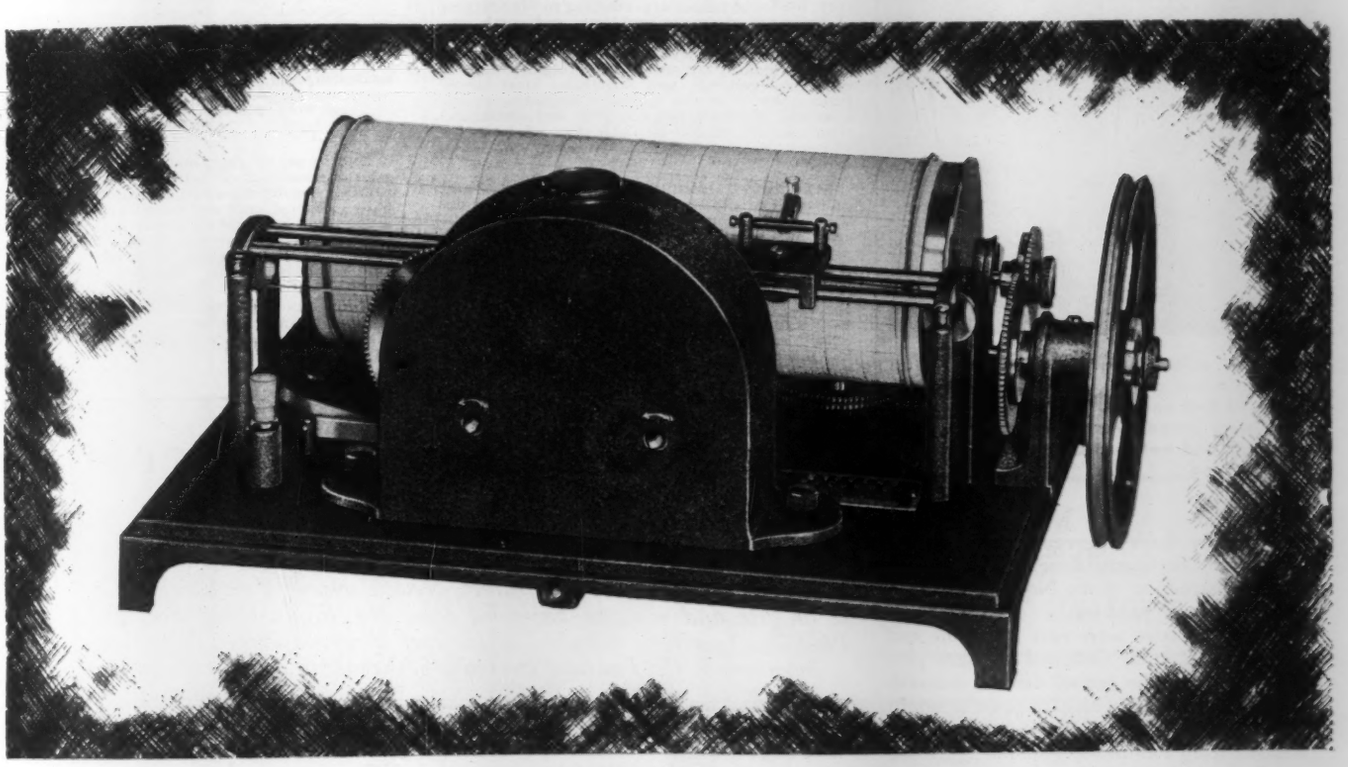
The Stevens *Type F* Recorder is a veteran in our line and is in constantly increasing demand. It is an inexpensive general utility recorder for daily or weekly service, unlimited in range. *Type F* is particularly suited for securing ground water levels in deep wells; for stream gaging, irrigation, domestic water supplies, sewerage; and for use with weirs, Parshall flumes, Venturi tubes, or any other type of measuring device in which heights, or the differences in heights, are an index of flow.



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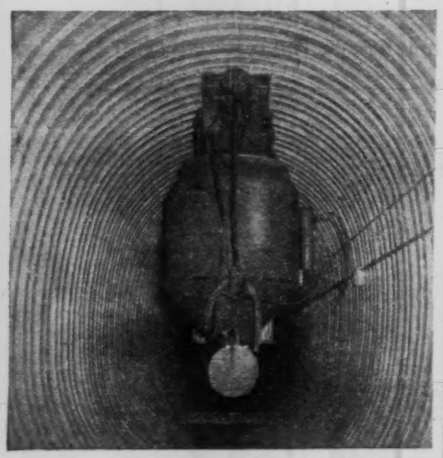

Rear view of weighing hopper. This elliptical batching tunnel of No. 10 gage Armco Steel is 11 by 13 feet and 460 feet long. Raw aggregates were stored over a 10-foot tunnel, 260 feet long, and wet sand over an 8-foot tunnel, 190 feet long.

This is how three aggregate tunnels built of ARMCO Corrugated Liner Plates helped speed construction of the Norfork Dam—a 1,500,000 cubic yard job.

First, the plates were easy to handle and install. Then, their designed strength permitted placing the tunnel directly beneath the aggregate pile, which attained a height of 60 feet. Delays caused by freezing in cold weather were avoided because the aggregate was handled from the bottom.

Armco's method of bolted construction made it a simple matter to locate the hoppers at any desired point. When the job was done the ARMCO Liner Plates were removed, nested together and stored in a minimum of space for future use.

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ENGINEER-PROFESSOR; Assoc. M. ASCE; B.S. in C.E.; M.S. in geology; 38; licensed professional engineer and land surveyor; 18 years structural design: bridges, multi-story and industrial buildings, harbor works, fortifications, shipyard structures; 14 years as evening instructor in structural and civil engineering. Desire responsible position, or position on college faculty. Available immediately. C-246.

POSITIONS AVAILABLE

MUNICIPAL ENGINEER, civil graduate, thoroughly qualified to supervise the construction of projects, such as incinerator, garage, sewer systems, road work, etc., for town of about 25,000 residents. Must know building costs, estimating, etc. Salary open. Location, Connecticut. W-6526.

STRUCTURAL ENGINEER who is experienced in the design of locks, dams, spillway gates, etc. Should be experienced in both concrete and steel design. Must be able to supervise the preparation of detailed drawings for such structures. Salary open. Location, Florida. W-6559.

ENGINEERS. (*a*) Structural Engineer, graduate, thoroughly experienced in the design of reinforced concrete and structural steel as pertaining to buildings. (*b*) Structural Engineer, graduate, thoroughly experienced in soil mechanics (laboratory, field, and office) as pertaining to foundations of buildings, drainage problems, and earth embankments. Salaries, $4,300 a year. (*c*) Structural Engineering Draftsmen thoroughly experienced in making layouts and working drawings of reinforced concrete and structural steel structures. Should be able to design simple structural members in reinforced concrete and structural steel. Salary, $2,980–$3,640 a year. Salaries for 40-hour week. Location, Washington, D.C. W-6566.

STRUCTURAL DESIGNERS, with power plant and industrial process construction experience, to design and lay out structures, piping, conveyors, etc. Salary open. Location, Virginia. W-6572.

ASSISTANT OR ASSOCIATE PROFESSOR, 35–40, for department of civil engineering, to teach course in structures, structural design, reinforced concrete theory and design. Prefer man who has had actual office experience in an engineering office; some design experience. Need not have had teaching experience, but must be interested in the field. Excellent opportunity in large university. Salary on yearly basis with one month's vacation. Opportunity for outside consulting work. Position starts September 1946. Location, New York State. W-6620.

YOUNG ENGINEER with some training in civil engineering and the ability to write. Work includes preparation of semi-technical booklets, design manuals, product catalogs, and direct mail material. Location, Ohio. W-6630D.

ASSISTANT PLANT ENGINEER, 30–35, civil graduate, with at least 3 years outside construction work and 5 years' inside industrial type construction work. Should have 2 years' all-around estimating experience, and have good working knowledge of boilers and power house. Must have had experience handling construction type labor, both inside and outside plant. Write giving education and experience. Salary, $4,000–$5,000 a year. Location, upstate New York. W-6637.

CONSTRUCTION ENGINEER, 25–35, civil graduate, with at least 5 years' experience with general contractor in office and field. Experience must include design and detail of industrial buildings and layout of process equipment. Salary open. Location, northern Ohio. W-6651D.

DESIGNER-DRAFTSMAN for structural steel and reinforced concrete bridges and buildings. Should know analysis of indeterminate structures. Salary, $3,600 a year. Also need a good draftsman with experience in structural steel. Location, West Virginia. W-6653.

CONSTRUCTION EXECUTIVE thoroughly experienced in every branch of building construction, estimating and field work. Must be an able negotiator and capable of assuming full responsibility for large work, public and private. Write stating salary desired. Location, New York, N.Y. W-6657.

ENGINEER to coordinate and field train the sales organization of nationally established engineering, construction and consulting firm. Must have technical sales and sales management background and have ability to contact and close important contacts with chief executives and engineers. Permanent. Write giving full details and recent snapshot. Location, Pennsylvania. W-6675.

ENGINEER DESIGNER, civil, structural and material handling work for an old-established mining company. Salary, $4,800 a year. Location, Michigan. W-6710D.

Current Periodical Literature

Abstracts of Magazine Articles on Civil Engineering Subjects

Selected items for the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file and may be borrowed from the Engineering Societies Library. Photoprints will be supplied at the cost of reproduction, 25 cents per page to members of the Founder Societies (30 cents to all others), plus postage.

BRIDGES

ABUTMENTS, CONCRETE. Emergency Concrete Block Abutment, H. M. Mumaugh. *Eng. News-Rec.*, vol. 135, no. 22, Nov. 29, 1945, pp. 744–745. Abutment built of pre-cast concrete blocks and transit-mix concrete, with blocks serving as forms for placing concrete due to lack of lumber and form builders.

CONCRETE ARCH, ONTARIO. New Bridge in Toronto Suburb. *Roads & Bridges*, vol. 83, no. 11, Nov. 1945, pp. 56–57, 126, and 128. Concrete-arch structure, 1,000 ft long, planned to give access to military hospital; dimensions, financing, and design proposals given.

HIGHWAY, ALEXANDRIA, VA.–WASHINGTON, D.C. Potomac Bridge Controversy, H. James. *Landscape Architecture*, vol. 35, no. 3, Apr. 1945, pp. 85–97. Review of opposing arguments as to whether there should be one 6-lane or two 4-lane bridges across Potomac to take place of 14th St. Bridge; opinion of various agencies.

HIGHWAY, GERMANY. "Friendship Bridge" Over Elbe, B. R. Kramer. *Military Engr.*, vol. 37, no. 241, Nov. 1945, pp. 450–452. Permanent highway bridge designed to carry one-way Class-70 and two-way Class-40 loads; structure, materials, equipment, organization, and construction described.

HIGHWAY, MAINTENANCE AND REPAIR. Bridge Maintenance Practice on California Highway System—VI, K. Elder. *Calif. Highways & Pub. Works*, vol. 23, nos. 9–10, Sept.-Oct. 1945, pp. 10–14. Problem of improving clearances on highway structures.

HIGHWAY, MAINTENANCE AND REPAIR. Restoring California Highway Bridges, M. A. Ewing. *Concrete*, vol. 53, no. 11, Nov. 1945, pp. 2–5. Repair of structure settlement resulting from stream scour; difficulty arising from presence of water; procedures for additional protection.

MILITARY. Design for Bridging, F. X. Purcell, Jr. *Military Engr.*, vol. 37, no. 241, Nov. 1945, pp. 440–445. Mission assigned to Engineer Regiment for drawing design of bridge to carry Class 70 loading over Rhine and to pass tugs and barges underneath.

MILITARY. Manufacturing Bailey Bridge, R. S. Bishop and K. S. Frazier. *Military Engr.*, vol. 37, no. 236, June 1945, pp. 219–222. Problems of development and methods of construction briefly described.

MILITARY. Spanning Rhine, R. L. Malconian and R. L. Boyer. *Military Engr.*, vol. 37, no. 241, Nov. 1945, pp. 456–457. Construction of 969-ft Class-36 heavy pontoon bridge, and 1,170 ft Class-36 bridge, built in 16½ hr.

MILITARY, ALUMINUM. Aluminum Half Pontoon, J. P. Arens. *Modern Metals*, vol. 1, no. 11, Dec. 1945, pp. 16–17. Factors pertaining to fabrication, assembling, and finishing of half pontoons for Army M-4 bridges at Ceco Steel Products; brief data on aluminum used, bridge applications, and installation details.

MILITARY, BURMA. Irrawaddy Bridge, Ledo Road, J. Truitt. *Military Engr.*, vol. 37, no. 240, Oct. 1945, pp. 406–408. Conditions dictated adoption of design as floating bridge over deeper portion of river, fixed bridge for shallower section, and system of transition spans to provide usable gradient throughout range.

RAILROAD, MAINTENANCE AND REPAIR. How Heintz Replaced Longview Bridge Approach with Earth Fill. *Pac. Bldr. & Engr.*, vol. 51, no. 11, Nov. 1945, pp. 46–47. Replacement carried out without delaying traffic, by working on half of bridge width at one time while traffic used other half.

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Dallas J. W. Bartholow Machinery Co.
Houston Peden Iron & Steel
San Antonio Alamo Iron Works
UTAH
Salt Lake City Colorado Builders Supply Co.
VIRGINIA
Norfolk Tidewater Supply Co.
Richmond Virginia Steel Co.
Roanoke Tidewater Supply Co.
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By ELWYN E. SEELYE

(1945) 417 Pages $7.50

Nowhere else in one volume today will you find all the design data that are concentrated in this book. Over 400 pages of plates cover the main fields of civil engineering—structures, sanitation, water supply, drainage, roads, airfields, dams, docks, bridges and soils. Information is graphically presented, so that diagrams, charts, illustrations, and numerous time- and labor-saving tables cover each point clearly, completely. DATA BOOK—DESIGN will expand the field of activity of the experienced engineer. Inexperienced engineers will find that this book helps eliminate costly mistakes.

WATER BACTERIOLOGY—Sixth Edition

By SAMUEL CATE PRESCOTT, CHARLES-EDWARD AMORY WINSLOW, and M. H. McCRADY

Ready March 1946) 368 Pages $4.50

Almost wholly rewritten and completely modernized, this new edition has been revised with particular consideration for the needs of the practical laboratory analyst and the research worker. It features a treatment of bacteriological methods of water examination, of official standards based on their use, and furnishes the necessary background for an understanding of current methods and standards.

DESIGN OF REINFORCED CONCRETE STRUCTURES—Second Edition

By DEAN PEABODY, JR.

(Ready April 1946) Approx. 527 Pages Probable Price $5.00

Newly expanded and revised, this well-known, reliable reference offers a wealth of the latest theoretical and practical information. Includes a thorough treatment of Saliger and Whitney's "plastic theory of design," and the use of prestressed concrete for pipes, tanks, and beams.

ENGINEERING FOR DAMS

By WILLIAM P. CREAGER, JOEL D. JUSTIN, and JULIAN HINDS

1945) Vols. I, II, III 929 Pages $15.00 the set

A complete treatise, in three volumes, covering every type of dam known to modern engineering. An invaluable reference, work for the practicing engineer, thorough in its detailed treatment of the theory of design and its applications. Vol. I: Design; Vol. II: Concrete Dams; Vol. III: Earth, Rock Fill Steel and Timber Dams.

STATICALLY INDETERMINATE STRUCTURES

By LAWRENCE C. MAUGH

(Ready April 1946) Approx. 340 Pages Probable Price $4.50

The most modern material on the application of structural mechanics to the problems of engineers working on industrial buildings and aeronautical and marine structures. Combines an adequate treatment of the fundamental theory with practical applications. Features useful illustrations and carefully selected problem material.

AIRPORT PLANNING

By CHARLES FROESCH and WALTHER PROKOSCH

(Ready May 1946) Approx. 259 Pages Probable Price $6.00

The first book to stress the interrelationship between airplane, airfield, and airport building design. Discusses the factors involved in building new airfields and modernizing existing ones to serve small as well as large communities.

ENGINEERING CONTRACTS AND SPECIFICATIONS

By ROBERT W. ABBETT

(1945) 188 Pages $2.25

A comprehensive treatment of the latest legal and business aspects of engineering and architectural practice, presented in clear, non-technical language. Thoroughly practical and up to date, this book is conveniently arranged for ready reference.

THEORETICAL SOIL MECHANICS

By KARL TERZAGHI

(1943) 510 Pages $5.00

Here for the first time, tested theories of soil mechanics are completely treated and critically evaluated. This book also establishes the theoretical principles of earth pressure, stability and settlement computations.

A TREATISE ON APPLIED HYDRAULICS—Third Edition

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STEEL TRUSS, AUSTRALIA. Deep Foundation and Welded Truss Feature Unusual Australian Bridge. *Eng. News-Rec.*, vol. 135, no. 26, Dec. 27, 1945, pp. 864–867. New bridge across Hawkesbury River in New South Wales, has two 438-ft through-truss spans that are entirely shop welded, said to be longest trusses in world built by this method; trusses rest on pier, constructed by open-caisson method, that is within 8 in. of deepest in world.

STEEL TRUSS, MAINTENANCE AND REPAIR. How Hawthorne Bridge, Portland, Got Its Face Lifted, A. R. Fairbank. *Pac. Bldr. & Engr.*, vol. 51, no. 11, Nov. 1945, pp. 44–45. Replacement of timber deck with open-mesh steel grating and other repair jobs carried out without interruption of regular traffic flow.

SUSPENSION, TACOMA, WASH. Redesign of Tacoma Narrows Bridge, C. E. Andrew. *Eng. News-Rec.*, vol. 135, no. 22, Nov. 29, 1945, pp. 716–721. Possibility of vibration resulting from aerodynamic forces considered in redesign, based on results of 4-year research program in specially designed wind tunnel with throat section of 10 by 100 ft; model tests described.

VIADUCTS. Pecos Gorge in Texas Spanned by New Railroad Bridge, H. J. Engel. *Eng. News-Rec.*, vol. 135, no. 20, Nov. 15, 1945, pp. 654–659. Built during war to replace famous and spectacular, but light and inadequate, viaduct over gorge of Pecos River in Texas, new bridge of Southern Pacific is designed for E-72 live loads plus earthquake and wind forces; continuous cantilever deck structure, its hollow concrete piers rise to 275 ft and were built with slip forms; provisions were made in superstructure design to facilitate cantilever erection.

BUILDINGS

HOSPITALS, TROPICS. Pacific Hospitals Built of Sheet Steel. *Eng. News-Rec.*, vol. 135, no. 22, Nov. 29, 1945, pp. 729–731. Designed in 8-ft linear modules, numerous one-story Army hospitals built in Pacific area have framework of sheet steel formed to structural shapes and exterior covering of 2-ft-wide panels of sheet metal; floors are built of plywood, and sidewalls and ceiling are lined with wallboard; use of 8-ft. module permits variations in length of building and spacing of doors and windows.

ORDNANCE PLANTS, CONSTRUCTION. Men and Materials for $427,000,000 Job. *Eng. News-Rec.*, vol. 135, no. 24, Dec. 13, 1945, pp. 791–794. Problems of procurement of personnel and materials at Oak Ridge, Tenn., electromagnetic process plant for production of atomic bomb.

CITY AND REGIONAL PLANNING

CLEVELAND, OHIO. Democracy in Community Planning, S. B. Weston. *Am. City*, vol. 60, no. 11, Nov. 1945, pp. 104–105. Reasons for formation of Metropolitan Cleveland Development Council, and principles governing its actions.

OAK RIDGE, TENN. Building City from Scratch, E. A. Wende. *Eng. News-Rec.*, vol. 135, no. 24, Dec. 13, 1945, pp. 815–818. Prime considerations in planning and building housing development necessary for Clinton Engineer Works were speed, saving of critical materials, and minimum interference with local labor supply; requirements were met by adapting surplus materials and housing from other war projects, by laying out town on contour planning principles, and by eliminating much on-site labor through simplification of design and by prefabrication at localities well removed from construction site.

PLANNING AIRPORTS. New Uses for Old Blighted District, S. R. DeBoer. *Landscape Architecture*, vol. 35, no. 3, Apr. 1945, pp. 83–84. Proposal for downtown airport over blighted property in front of Denvor (Colo.) Union Station; railroad, air, bus and city transportation combined into one terminal; hotels and service shops fronting on port and located below it.

SOVIET UNION. Russian Urban Reconstruction Emphasizes Planning. *Am. City*, vol. 60, no. 11, Nov. 1945, p. 102. Brief description of plans being promulgated by various architectural agencies.

SUBDIVISION. Regional Planning Commission Promotes Uniformity in Subdivision Control, M. H. Dill. *Am. City*, vol. 60, no. 11, Nov. 1945, pp. 127, 129, 131, and 133. Rules adopted by Regional and Cincinnati Planning Commissions with respect to subdivision of land for residential development; general subdivision standards and design requirements.

CONCRETE

BRIDGE ABUTMENTS. Emergency Concrete Block Abutment, H. M. Mumaugh. *Eng. News-Rec.*, vol. 135, no. 22, Nov. 29, 1945, pp. 744–745. Abutment built of pre-cast concrete blocks and transit-mix concrete, with blocks serving as forms for placing concrete due to lack of lumber and form builders.

CHURCHES. New Temple for Idaho Falls, H. Tippetts. *Western Construction News*, vol. 20, no. 11, Nov. 1945, pp. 106–108. Modernistic Latter Day Saints Church, constructed at Idaho Falls, uses marble imported from Italy, France, and Sweden for lobby and altars; temple exterior is cast stone held in place with metal ties and anchors; cost nearly million dollars.

CONSTRUCTION, COLD WEATHER PROBLEMS. Electro-Concrete, K. Billing. *Instn. Civ. Engrs.*—

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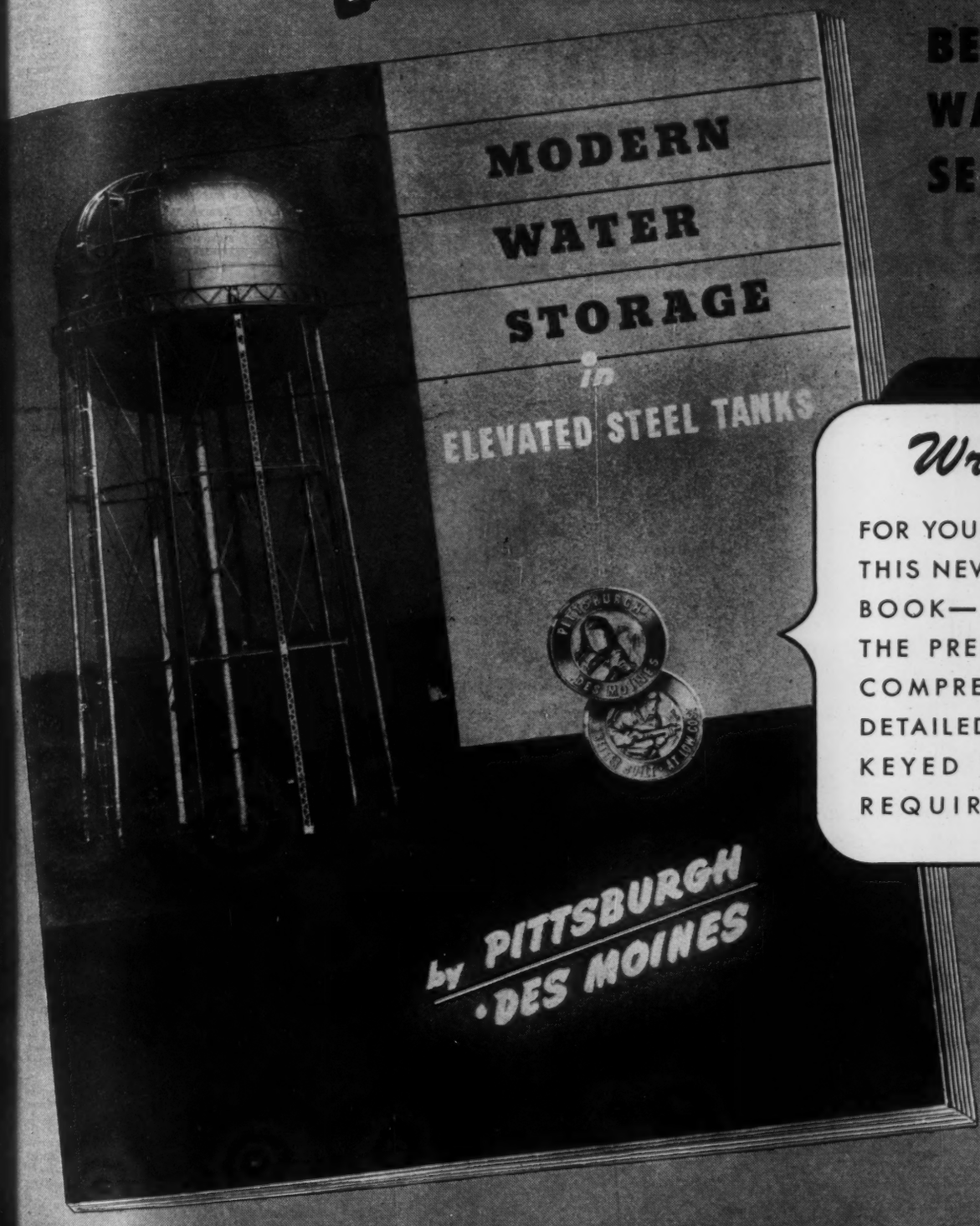

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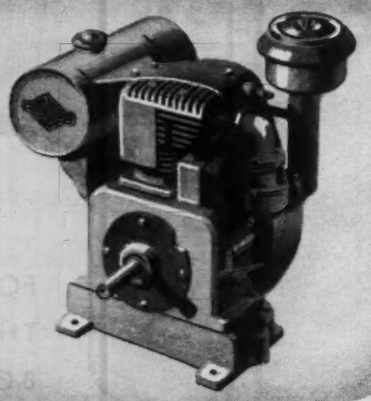

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J., vol. 24, no. 8, Oct. 1945, pp. 368–378. Where problem of freezing is met, electric current is passed through concrete by introducing poles into it, circuit being closed by fresh concrete itself; resistance of concrete transforms electric current into heat, and thus raises temperature of cold concrete; methods and equipment used in Soviet Union are used as basis for discussion.

DRYDOCKS. Precast Forms Used for Underwater Concrete. *Eng. News-Rec.*, vol. 135, no. 26, Dec. 27, 1945, pp. 868–872. Unusual saving of critically short steel shapes was accomplished on construction of three concrete graving docks at San Francisco by pre-casting forms from concrete and setting them deep under water to confine tremie-placed concrete for walls and floor.

MIXING. Weighing Out Seven Aggregate Sizes and Ready Mixed Concrete, O. H. Wustrack. *Rock Products*, vol. 48, no. 10, Oct. 1945, pp. 74–75, and 126. Batching of ready-mixed concrete combined with weighing-out aggregate to bulk users, at plant of W. G. Block Co., Davenport, Iowa; 7-bin hopper used above batching floor; twin aggregate batchers; 5-beam scale.

ORDNANCE PLANTS, WASHINGTON. Bomb Plant—Project Construction Masterpiece. *Western Construction News*, vol. 20, no. 11, Nov. 1945, pp. 98–101. Construction of plant described; tanks for handling liquids; heavy concrete buildings; concreting.

PIERS. Design Data on Permeable Concrete Piers. *Concrete*, vol. 53, no. 11, Nov. 1945, pp. 6–8. Construction of piers of double-wall type to combat erosion; advantages of double parallel wall type.

READY MIXED. Uniformity of Ready Mixed Concrete, S. Walker. *Concrete*, vol. 53, no. 11, Nov. 1945, pp. 36–39. Factors to be considered in control of ready-mixed concrete; types of mixing; central mixing procedure; transit-mixing operation; factors affecting consistency.

READY MIXED, FORT WORTH, TEX. Make Both Ready Mix and Lime Mortar, H. E. Swanson. *Rock Products*, vol. 48, no. 11, Nov. 1945, pp. 68–70, and 87. Description of ready-mixed concrete plant of Fort Worth Sand & Gravel Co.; method of batching and mixing; introducing pozzolith into batch; operation of 30 transit mixers described.

WATER TANKS AND TOWERS. Galesburg's Concrete Water Tower. *Am. City*, vol. 60, no. 11, Nov. 1945, pp. 106–107. To care for water requirements of new 2,000-bed Army general hospital, Galesburg, Ill., found it necessary to enlarge its supply; for this purpose monolithic prestressed overhead storage tank (with capacity of 750,000 gal.), new well, and mains to connect well and tank with city distribution system were built.

DAMS

CONCRETE ARCH, ARIZONA. Bridge Canyon Dam—Bigger Than Boulder. *Power Plant Eng.*, vol. 49, no. 10, Oct. 1945, pp. 80–81. Similar description of paper previously indexed from various sources.

CONCRETE ARCH, REPAIR. Concrete Drydock—to House Repair Caisson at Coulee. *Western Construction News*, vol. 20, no. 10, Oct. 1945, pp. 87–90. Drydock is to be used in building, storing, and maintaining floating, submersible, steel caisson, which will be utilized in repairing eroded concrete areas in "bucket" or apron at bottom of plunge pool below Grand Coulee Dam.

CONCRETE GRAVITY, OKLAHOMA. Altus Dam Rebuilt as Gravity Structure with Masonry Facing Used as Forms, W. S. Byrne. *Eng. News-Rec.*, vol. 135, no. 26, Dec. 27, 1945, pp. 860–863. Former slab- and buttress-type dam has been replaced by much higher gravity dam with stone masonry facing; stonework was laid up one course at time and was used as form for concrete, thus limiting height of each pour to about 20 in.; narrow width of structure near top resulted in varied procedure in placing mass concrete, which consists of lean mix with cement content reduced about 30% by addition of inert pumicite.

CONCRETE, REPAIR. New Concrete Blanket Mixed with Air-Entraining Cement Replaces Disintegrated Face of 40-Year-Old Dam, H. A. Moody. *Construction Methods*, vol. 27, no. 11, Nov. 1945, pp. 100–102, 190, and 192. Concrete on downstream face of dam removed and replaced with concrete blanket using air-entraining cement and anchored to sloping surface of existing structure by deformed steel dowels.

CONSTRUCTION, CABLEWAYS. Construction Cableways on Norfork Dam, H. V. Pittman. *Eng. News-Rec.*, vol. 135, no. 26, Dec. 27, 1945, pp. 879–883. Essential features of design, erection, mechanical operation, and control are given for world's longest construction cableways, used at Norfork Dam for placing 1,500,000 cu yd of concrete; description and diagnosis of cause of major failure of one of cableways are presented.

EARTH, CALIFORNIA. Conn Creek Dam—to Provide Napa Valley with Water. *Western Construction News*, vol. 20, no. 10, Oct. 1945, pp. 98–101. Design details of dam which will rise approximately 110 ft above original creek bed and impound 31,000 acre-ft of water; compacted earth-fill core is flanked on both upstream and downstream sides by heavy gravel fill; outlet tower and spillway described.

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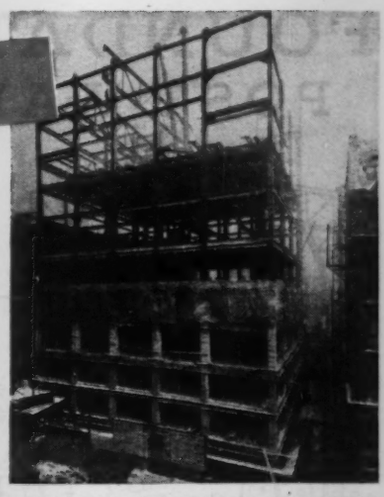

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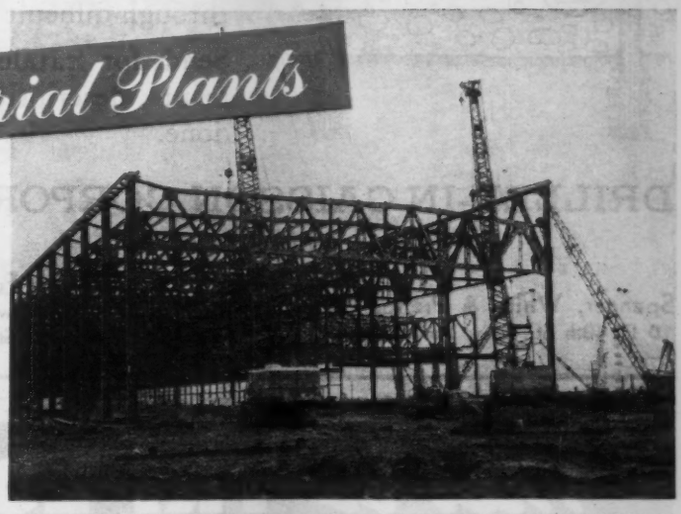

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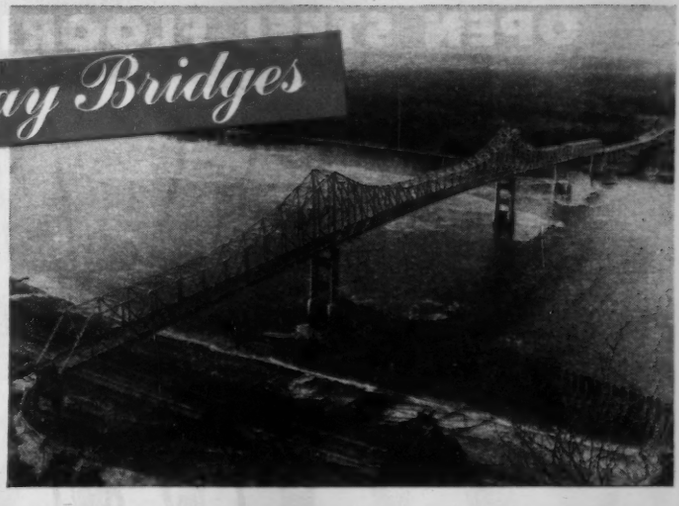

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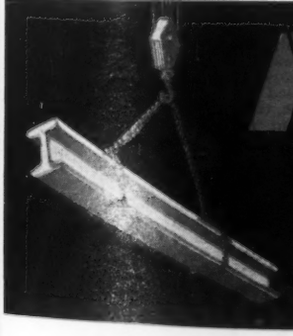

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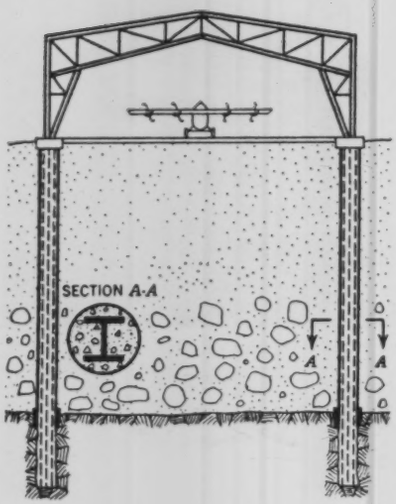

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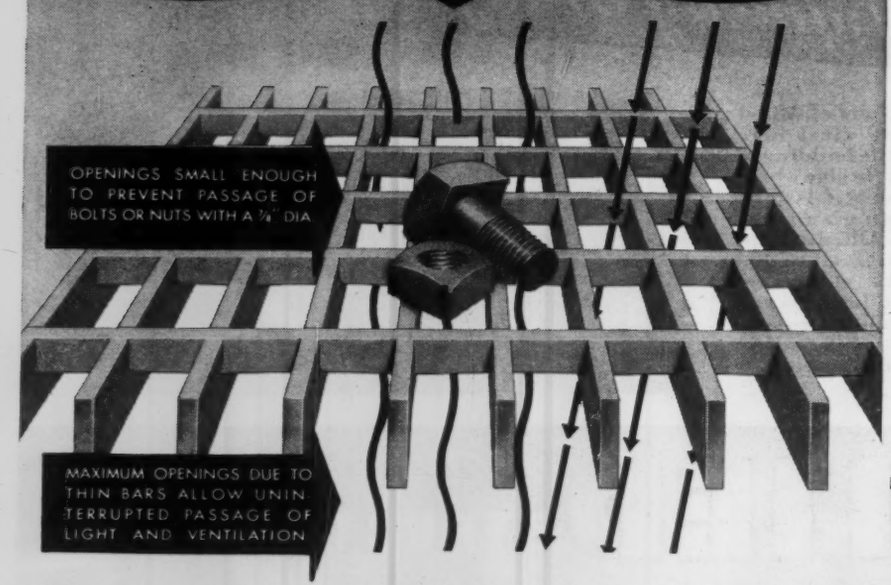
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EARTH, IDAHO. Concrete Work on World's Highest Earthfill Dam Nears Completion. *Construction Methods*, vol. 27, no. 11, Nov. 1945, pp. 116 and 156. Brief description of final work on Anderson Ranch Dam, which is to be 456 ft high, 2,500 ft wide at base, and 1,350 ft long at crest.

FONTANA DAM. Energy Dissipation at Fontana Spillway, A. A. Meyer. *Eng. News-Rec.*, vol. 135, no. 22, Nov. 29, 1945, pp. 738–741. Fontana Dam spillway has fall of 400 ft with water traveling through tunnels of velocities more than 100 mph; at end of each tunnel, concrete bucket of novel design spreads shooting water into thin jet that rises to 150 ft in air; where these jets are returned to natural river, energy dissipation takes place; substantial scours will have to occur before stable river, bottom is obtained but these scours will in no way affect safety of dam.

FONTANA DAM. Structural Behavior of Fontana Dam Revealed by Dual-Purpose Instruments, W. R. Waugh. *Eng. News-Rec.*, vol. 135, no. 20, Nov. 15, 1945, pp. 664–668. Special measuring instruments installed to give information for control of cooling and joint grouting; data are sought on strain and stress near base of maximum section of dam and boundary conditions at upstream and downstream faces; meters installed across longitudinal and transverse joints to determine changes at contraction joints, to observe movements of adjacent blocks during grouting, and to check subsequent changes.

SPILLWAYS. Semi-Circular Spillway in Action. *Eng. News-Rec.*, vol. 135, no. 20, Nov. 15, 1945, p. 653. Spillway built at Norfolk, Va., Lake Burnt Mills reservoir; flow over spillway collects in pool at center of curve, passes through hydraulic jump, and is returned to tail-water by curved concrete channel terminating in series of broad steps that dissipate remaining energy.

WEIRS, RECONSTRUCTION. Reconstruction of Diyala Weir, J. D. Atkinson and G. Cardiacos. *Instn. Civ. Engrs.—J.*, vol. 25, no. 1, Nov. 1945, pp. 22–46. Account of reconstruction work on weir located in Diyala River in Iran, to divert summer supply to canals as first stage in improvement of summer irrigation; original weir, repairs, and final design described.

FLOOD CONTROL

CALIFORNIA. Flood Control—Initiated in San Bernardino County, M. McMillin. *Western Construction News*, vol. 20, no. 11, Nov. 1945, pp. 87–89. Flood control program, incorporating construction of groins, levees, concrete channel, and concrete weir, briefly described.

RIVERS, IMPROVEMENT. Still-Water Pocket Principle, P. Claxton. *Instn. Civ. Engrs.—J.*, vol. 25, no. 1, Nov. 1945, pp. 47–61. Principle of still-water pocket is explained as efficient and economical means of river control, by which river training for miles upstream has been eliminated, and control confined to one point at work itself; applications are indicated.

FOUNDATIONS

BUILDINGS. Process Buildings Over Faulted Rock, L. Kerr and P. Brown. *Eng. News-Rec.*, vol. 135, no. 24, Dec. 13, 1945, pp. 795–797. Faulted rock, found under important building foundation, was utilized for support of heavy units of electromagnetic process of separation of uranium isotopes by unusually heavy foundation slab; for later building on similar rock basement space was obtained at no extra cost of excavating entire building area to top of limestone, then pouring thick base slab; buildings are concrete or steel frame.

ORDNANCE PLANTS. Compacted Fill Equals Natural Ground, J. D. Watson and O. R. Bradley. *Eng. News-Rec.*, vol. 135, no. 24, Dec. 13, 1945, pp. 810–812. Fills placed in 6-in. layers compacted with sheepsfoot rollers, with footings founded directly on top of new fills; problem of excess moisture in red clay.

SUBSOILS. How Erickson Uses Vertical Sand Drains to Stabilize Foundation for Fill. *Pac. Bldr. & Engr.*, vol. 51, no. 10, Oct. 1945, pp. 56–57. Vertical 18-ft sand-filled holes drain marshy area below fill and carry excess water to natural nearby drainage channel.

PILES, WOODEN, PRESERVATION. Drives Shotcrete Encased Piles. *Ry. Age*, vol. 119, no. 22, Dec. 1, 1945, pp. 888–889; see also *Ry. Eng. & Maintenance*, vol. 41, no. 12, Dec. 1945, pp. 1276–1277, and 1283. Because of severe marine-borer infestation in pile foundations of two of its waterfront piers, Southern Railway has recently redriven number of piles, pre-jacketed with concrete, in foundations; piles were pre-framed and given creosote treatment, following which they were jacketed with reinforced shotcrete, before being driven, to protect them against both teredo and limnoria; method employed is described.

HYDRAULIC ENGINEERING

FLOW OF WATER, OPEN CHANNELS. Some Problems and Considerations in Open Chanael Flow Measurement, R. E. Sprenkle. *Water Works & Sewerage*, vol. 92, no. 11, Nov. 1945, pp. 345–349. Brief description of various types of weirs used in measuring flow, advantages and disadvantages of weirs, types of flumes used, selection of proper primary element, methods of measuring level of fluid, use of mechanical and remote registers and control devices.

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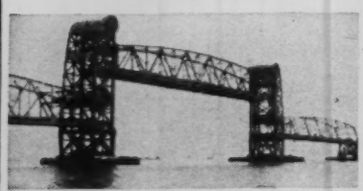

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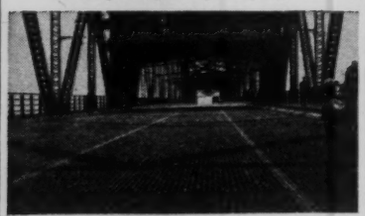

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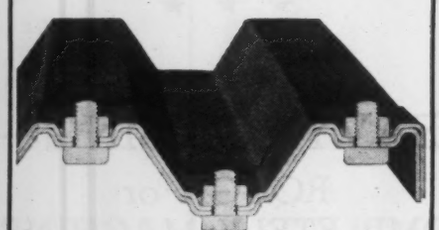

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HYDROELECTRIC POWER PLANTS

ALBERTA. Unusual Control Dam with Pumped Intake Special Features of Cascade Development. *Elec. News*, vol. 54, no. 18, Sept. 15, 1945, pp. 40–41, and 48. Calgary Power Company project, completed in record time despite wartime shortages, now provides over 90,000,000 kw hr of additional energy for system; special reference to concrete control dam; project consists essentially of storage reservoir having capacity of 182,000 acre-ft, earth canal 2½ miles in length, wood-stave pipe line 1,979 ft long, and power house.

FRANCE. St. Etienne-Cantales Dam. *Engineer*, vol. 180, no. 4676, Aug. 24, 1945, pp. 140–143. Illustrated description of dam and power plant constructed during war on River Cere, tributary of River Dordogne; reservoir dam is compromise between pure gravity type and arch dam, combining in single structure dam, power house, and waste weir; thicker in section than pure arch, it is less massive than true gravity dam; provision made for installation of three turbo-electric generator units, each of 25,000-kw.

INDIA. India on Threshold of Great Period of Hydro-Electric Development, S. Swayambu. *Elec. News*, vol. 54, no. 20, Oct. 15, 1945, pp. 34–36. Previously indexed from *Hydro News*, October 1945.

RESERVOIRS, DREDGING. Dredging to Regain Hydro Storage, A. J. Porter. *Elec. Light & Power*, vol. 23, no. 9, Sept. 1945, pp. 60, 121–122. Three years of dredging will be required to undo work of nature over 33-year period in depositing sand in Roslyn Lake, forebay and storage reservoir for station "O" hydroelectric plant, at Bull Run, near Portland, Ore.; dredging equipment illustrated and described; procedure for removing accumulation of sand.

TIDAL POWER, GREAT BRITAIN. Severn Tide Development Promises Cheap Power for England. *Power*, vol. 89, no. 11, Nov. 1945, pp. 732–733. Proposed tide power project in Severn River's estuary requires installation of thirty-two 25,000-kw hydroelectric units; turbines will operate under head of 5 to 32 ft, with annual power generation of over two billion kilowatt hours.

IRRIGATION

AGRICULTURAL ENGINEERING. Water Policy in Relation to Western Agriculture, C. R. Wickard. *Agric. Eng.*, vol. 26, no. 4, Apr. 1945, pp. 141–144. Responsibility of U.S. Dept. of Agriculture and War Food Administration in development, use, and disposal of water; two fundamental principles underlie Department's water policy for the West; one is conviction that ultimate goal of every irrigation project must be welfare of families who make homes on land; other is that water policy, to be fully effective, must be part of comprehensive policy for wise use of all of nation's natural resources. Before Am. Soc. Agric. Engrs.

IRRIGATION CANALS. Doubling Provo River Irrigation, L. H. Houck. *Excavating Engr.*, vol. 39, no. 11, Nov. 1945, pp. 608–611, and 665. J. B. & R. E. Walker, Inc., of Salt Lake City, is finishing four-job contract of modernizing Provo Reservoir Canal in Utah, unit of one of oldest irrigation systems in U.S., by replacing wood-stave pipes with concrete siphons which will enable system to more than double its capacity.

IRRIGATION CANALS, WASHINGTON. Siphons Feature Yakima Canal, C. L. Tyler. *Western Construction News*, vol. 20, no. 11, Nov. 1945, pp. 92–95. Construction of siphons and waste-ways described.

LAND RECLAMATION AND DRAINAGE

AIRPORTS. Shoulder Gutters Check Airfield Erosion, H. A. Scott. *Eng. News-Rec.*, vol. 135, no. 22, Nov. 29, 1945, pp. 732–734. Erosion by storm runoff endangered runways at Jacksonville, Fla., airfield; wide gutters, discharging to catch basins or spillways, were constructed at edges of shoulders; surveys show no erosion since gutters have been in operation despite heavy rainfall.

MALARIA CONTROL, TRINIDAD. Anti-Malaria Drainage in Trinidad, G. A. Campbell. *Eng. J.*, vol. 28, no. 11, Nov. 1945, pp. 695–702. Account of drainage structures built at Point Fortin as malaria-control measure; costs also included.

MATERIALS TESTING

SOILS, MOISTURE. Obtaining Soil Cores for Permeability Tests, W. E. Goode and J. E. Christiansen. *Agric. Eng.*, vol. 26, no. 4, Apr. 1945, pp. 153–155. Methods and equipment for obtaining large undisturbed soil cores for permeability tests have been devised and more than 50 cores have been obtained and tested; sealing space between core and wall of cylinder with dry, sieved soil proved satisfactory; use of transparent plastic cylinders has made it possible to obtain tight-fitting cores which eliminate necessity for sealing.

PORTS AND MARITIME STRUCTURES

BREAKWATERS. Mole Calms Navy Base Tides. *Western Construction News*, vol. 20, no. 10, Oct. 1945, pp. 91–94. Vital naval repair program at 60-million-dollar operating base on Terminal Island, Los Angeles Harbor, endangered by unusual and complicated wave actions, so extensive breakwater construction was undertaken, using rock-protected sand-fill mole, and entrance channels dredged.

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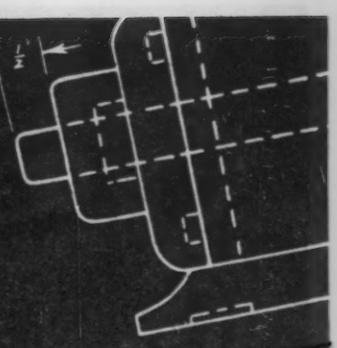

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CONSTRUCTION. Port Construction in Pacific. J. A. Riley. *Military Engr.*, vol. 37, no. 241, Nov. 1945, pp. 433–436. Organization and equipment, work accomplished, construction procedures and other activities of Engineer Port Construction and Repair Organizations of Army.

PALAU ISLANDS. Harbor Construction at Peleliu, K. P. Doane. *Military Engr.*, vol. 37, no. 240, Oct. 1945, pp. 414–418. Landing causeways established by use of pontoons, assembled into sections—2 pontoons wide and 30 long; dredging channel and small boat harbor; boat basin construction and facilities.

PIERS, CONSTRUCTION. Sand Fill 60′ High in Deep Tidewater, G. T. Treadwell. *Pac. Bldr. & Engr.*, vol. 51, no. 11, Nov. 1945, pp. 54, 56–57 and 60. Notes on construction of 1,019 by 306-ft pier into Elliott Bay, Port of Seattle, Wash.; in order to build pier, earth-fill center section was placed inside solid steel bulkhead formed by Z-32 steel sheet piles up to 60 ft long.

ROADS AND STREETS

AIRPORT RUNWAYS, CONSTRUCTION. Giant Rollers Compact Airfield Subgrades. *Construction Methods*, vol. 27, no. 11, Nov. 1945, pp. 111, 178 and 180. Sheepsfoot roller with steel feet 18 in. long with diamond-shaped pads, welded to surface of drum 8 ft in diameter and 10 ft long, used to compact subgrade in place in one operation.

ASPHALT. Some Aspects of Post-War Asphalt Paving, A. W. Attwooll. *Roads and Road Construction*, vol. 23, no. 274, Oct. 1, 1945, pp. 313–317. Road-surface problems summarized under four groups; general character and function of thin application mixtures; laying asphalt surfaces; uniformity of surface.

CONSTRUCTION. Grading Washington Highway. *Western Construction News*, vol. 20, no. 10 Oct. 1945, pp. 95–97. Vertical sand drainage system used in construction of section of U.S. Highway 99; problems of traffic and grading.

DESIGN. Highway Planning with Particular Reference to Traffic Capacities, R. Nicholas. *Surveyor*, vol. 104, no. 2809, Nov. 23, 1945, pp. 721–722. Estimation of likely future increases in traffic must be considered as important factor in highway planning; traffic capacities in built-up areas; intersections.

FROST EFFECT. What Causes Spring Break-Up? A. M. Williams. *Better Roads*, vol. 15, no. 11, Nov. 1945, pp. 22–23. Observations and explorations in central Michigan over period of years suggest explanation in terms of form frost takes in entering and leaving road-bed; severity of break-up is dependent on time of first "deep freeze" and amount of liquid precipitation thereafter.

HIGHWAY ENGINEERING, RESEARCH. Research Progress in Kansas During Construction Inactivity, R. C. Keeling. *Am. Highways*, vol. 34, no. 4, Oct. 1945, pp. 12–13. Brief account of research work; concrete and concrete pavements, flexible surfaces and bases; soils; experimental paving project; strengths of various concrete pavements in service after various ages.

HIGHWAY SYSTEMS, PLANNING. Analysis of Urban Travel by Survey Technique, T. Macdonald. *Passenger Transport J.*, vol. 93, no. 2307, Nov. 16, 1945, pp. 283–290. Author describes methods employed for obtaining data of public travel habits and needs by surveys of public opinion; factors involved in ascertaining information and interview data are discussed; advantages provided by surveys from administrative and analyst viewpoint are outlined.

MAINTENANCE AND REPAIR. Concrete Road Slab Recapped with 8-In. Slab. *Concrete*, vol. 53, no. 11, Nov. 1945, pp. 14–5, and 22. Description of method used in concrete resurfacing on Route 91 in Illinois; placement of 8-in. uniform concrete slab covered by layer of crushed stone to compacted depth of 3 in.

MAINTENANCE AND REPAIR. Raising Sagging Pavements and Runways, by Subsealing with Asphalt, H. A. Wallace. *Roads & Bridges*, vol. 83, no. 11, Nov. 1945, pp. 65–67, 100, and 102. Pumping hot asphalt through holes bored in concrete pavement to seal cracks and joints from bottom and to stop pumping of subgrade material to surface has been proved by Ohio State Highway Department to be very successful method of curing one of greatest problems of maintaining rigid pavements.

ROADSIDE IMPROVEMENT. Roadside Work Can Cut Upkeep, H. J. Neale. *Better Roads*, vol. 15, no. 11, Nov. 1945, pp. 24, 44, and 46. Roadside development contributes to reduction of maintenance costs principally by eliminating erosion and providing more satisfactory drainage.

SIDEWALKS. Designing Highway to Meet Pedestrian Needs, C. B. McCullough. *Roads & Bridges*, vol. 83, no. 11, Nov. 1945, pp. 60–61, 94, 96, and 98. Problem of protection of pedestrian on rural highways; education; cost allocation for pedestrian ways; design of rural roads for pedestrians; determining priority schedules for pedestrian ways.

SOILS, CONSOLIDATION. Tests of Compacted Clay Soils Provide Highway Design Guides, H. C. Porter. *Eng. News-Rec.*, vol. 135, no. 22, Nov. 29, 1945, pp. 726–728. Corroborative laboratory tests modify conclusions reached in tests recorded in *Eng. News-Rec.*, August 23,

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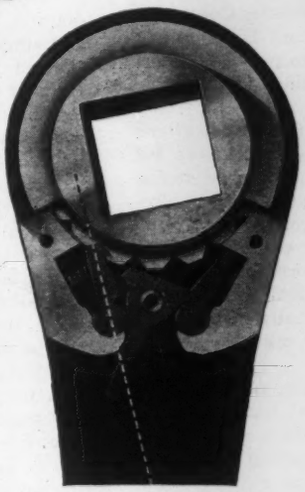

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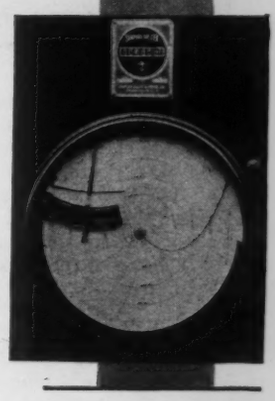

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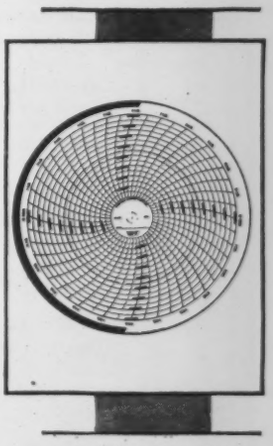

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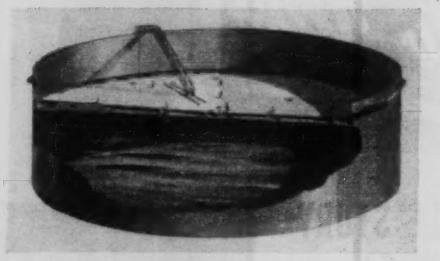
New Developments of Interest, as Reported by Manufacturers

Horton Floating Roof

AN IMPROVED HORTON Floating Roof, of double-deck construction, has been developed by the Chicago Bridge & Iron Company, Chicago, Ill. It is used on flat-bottom tanks storing volatile liquids.



The double-deck construction insulates the liquid and eliminates practically all boiling, thus extending the range of products previously stored in floating roof tanks. The bottom of the deck is sloped up toward the center and the roof is designed to vent all air from beneath the deck. The top of the deck is smooth and slopes toward the drain located at the center.

The Horton seal closes the space between the tank shell and the deck. A sealing ring forms a long sliding contact with the tank shell and is joined to the deck by a continuous gastight curtain.

New Airco Electrode

A NEW ALL-POSITION mild steel electrode, called Airco No. 312, has been announced by Air Reduction Sales Company, 60 East 42nd St., New York 17, N.Y. It was designed primarily to prevent underbead cracking in the welding of hardenable steels.

Laboratory tests and field applications indicate this electrode is satisfactory for welding: Low alloy, high tensile steels, particularly in heavy sections where preheat must be used with conventional type electrodes to minimize cracking; Free machining steels which normally run quite high in sulfur; Cold-rolled steels where excessive porosity is normally encountered with conventional type mild steel electrodes.

For material to be vitreous-enameled after welding, this electrode makes possible production of highly satisfactory enameled surfaces without any preheat treatment prior to the enameling operation, something that is impossible with conventional mild type steel electrodes.

Airco No. 312 should also prove much more suitable than conventional mild type steel electrodes on low alloy or mild steel applications where stress relieving would be desirable but cannot be accomplished, either due to lack of facilities or the magnitude of the application.

Two New Weld-Spatter-Resistant Compounds

TWO NEW weld-spatter-resistant compounds, No. 9951 and No. 9952, have been announced by the Electric Welding Division of the General Electric Company. Both of the new compounds are specially formulated for use in the welding field wherever weld spatter is undesirable and must be avoided easily and economically.

Furnished in powder form, ready to be mixed with water, the compounds are identical in performance. The only difference between them is that the No. 9951 is non-adherent and can be readily removed with an air hose or a dry cloth, while the No. 9952 is semi-adherent but can be quickly and easily removed with a damp cloth or a direct stream of water.

A feature of these compounds is that the surface of the work, even if slightly oily, does not require wetting before they can be applied. Another feature is that a special ingredient in the compounds eliminates the necessity of a water-soluble binder in order to obtain adhesion. Therefore, since the compounds are inert and cannot burn, they are completely smokeless.

Available from distributors, the compounds are easily mixed and applied. Water is added slowly until a thin paste is obtained. No lumping occurs, and the mixture can be applied with an ordinary bristle brush. The brush can be safely left in the compounds afterwards or readily cleaned with cold water.

These new compounds are economical to use, since one gallon of either will adequately cover 450 to 750 sq ft of work, depending upon the thickness with which the compound is applied.

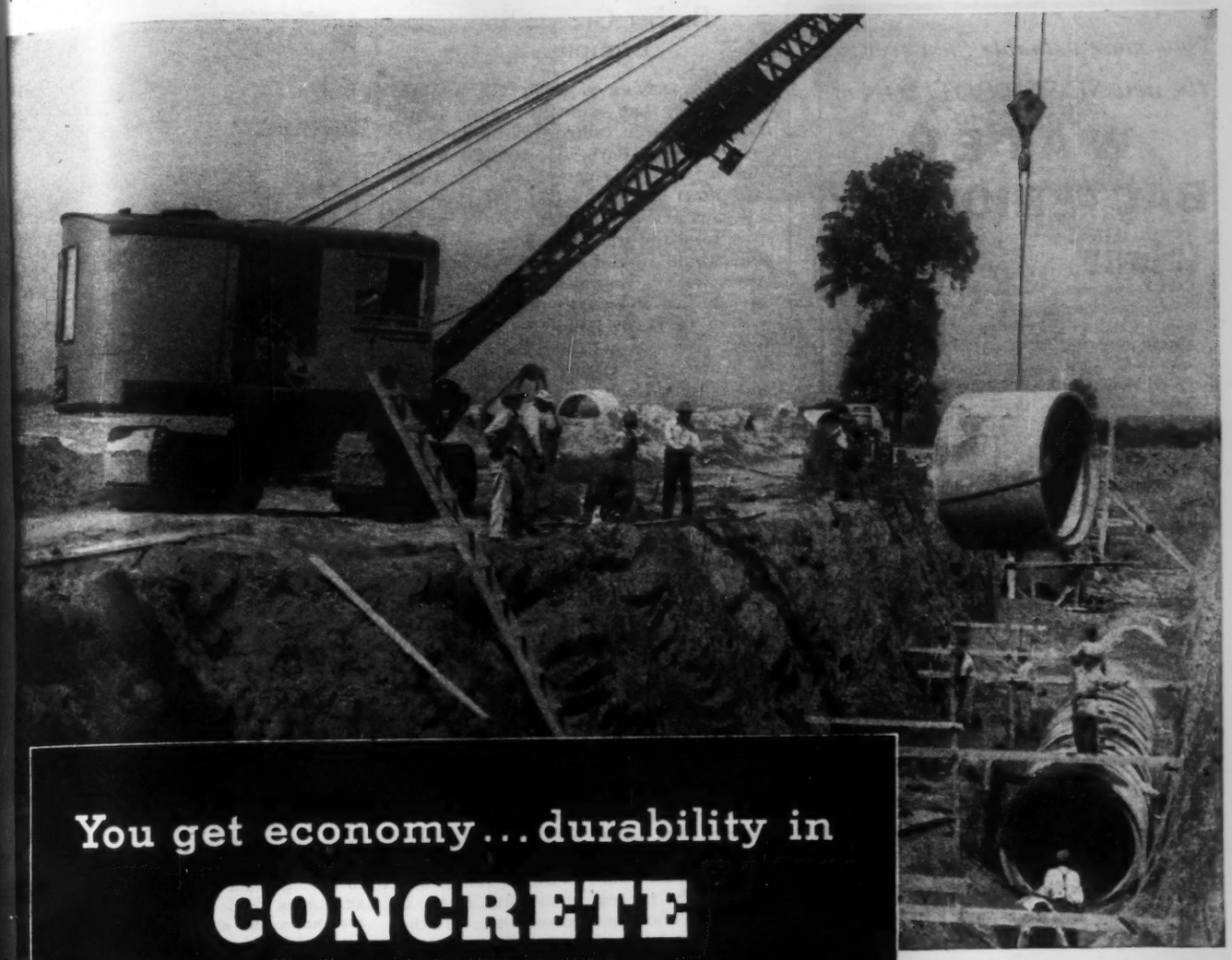
Caterpillar Scrapers

PRODUCTION OF three sizes of open-bowl scrapers, matched in capacity to the power of "Caterpillar" Diesel Tractors, is announced by Caterpillar Tractor Co., Peoria, Ill. The new scrapers, designated as Nos. 80, 70, and 60, have respective struck measures of 13.8, 8.7, and 6.0 yd. The many features of the scrapers, pointed out by the manufacturer, include: Open-bowl design for greater stability, visibility and access for shovel or dragline loading—High apron lift to clear the stickiest materials—Positive, clean ejection—Long cable life from correct reeving, oversized precision-grooved sheaves—Double-curved, shelf-sharpening cutting edges for "live loading" with longer boiling action, digging hard material, shorter loading distance and loading time—optional tire sizes for correct flotation, tires matched to the job, minimum rolling resistance, bigger pay-loads and longer tire life.

Morse Boulger Acquires Chem-Feeds, Inc.

MORSE BOULGER Destructor Company, New York 17, N.Y., has purchased Chem-Feeds, Inc., Providence, R.I., and will carry on the business as The Chemical Feeders Division of Morse Boulger Destructor Company. Chem-Feeds, Inc., was started and developed by Jeff Corydon II, well known in connection with the feeding and proportioning of chemicals. Mr. Corydon will head up this new division of Morse Boulger.

The outstanding feature of the Vari-Feeder, the company's principal product, is the control by speed. It can pump at speeds up to 400 strokes per minute and enables the operator to accurately control the proportioning since its speed can be adjusted by hand without shutting down the pump. The apparatus is capable of "Controlled" feeding of any wet chemical and against pressures where required.



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Barber-Greene Snow Equipment

A NEW ANSWER to paralyzing snowfalls and drifts that annually cause costly traffic tie-ups in railroad yards has been developed by Barber-Greene Company, Aurora, Ill. This new machine literally eats snow; instead of throwing it to one side, this new development scoops up the snow from the track, discharges it into a hungry tank, and digests it by turning it into water for easy disposal. Known as the Barber-Greene Snow Melter, the equipment consists of two separate car units: the Barber-Greene Model 568 Railroad Snow Loader, and a Melting Tank unit. Each unit is built integral with a 70-ton flat car and operates in conjunction with and ahead of a heavy freight locomotive, which furnishes motive power and steam to melt the snow.

Snow is removed from the track by the Loading Unit, and is carried upward by two continuous belt conveyors, then into a hopper at the top of the melting unit.

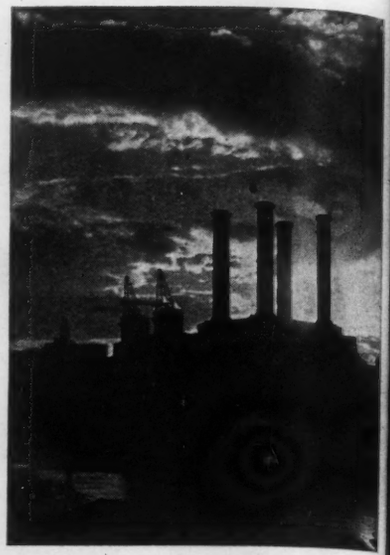
The melting process is accomplished by dumping the snow directly into water heated to the boiling point by steam injection. Two tanks are on the Melting Unit. To start the process of melting, water is heated to boiling temperature in the smaller or heating tank, then flooded through large gate valves into the larger tank, giving an initial depth of about 2 ft of boiling water in the melting tank—the gate valves remaining open.

Snow, discharged from the loader, falls into the hot water, directly in front of a bank of steam injection nozzles which cause agitation and circulation of the dissolving snow and also keep the accumulating water heated.

When the melted snow has filled both tanks, the loading process is halted. The gate valves are then closed, and steam turned on into the heating tank. The water in the larger or melting tank is dumped into a convenient drain or catch basin, and by the time this is accomplished the water in the heating tank is boiling and the cycle starts over again.

New Wire Rope Clamp

A NEW WIRE clamp called Cabl-Ox has been developed by the Nunn Manufacturing Co., 2125 Dewey Ave., Evanston, Ill. The Cabl-Ox clamp is claimed to incorporate a new wedging action in its component parts. The unit is alloy steel, cadmium plated for weather protection, streamlined for appearance and freedom from obstruction. Cable-Ox is easily assembled by unskilled labor and may be readily disassembled. Made in standard sizes from $1/16$ to $3/4$ in.



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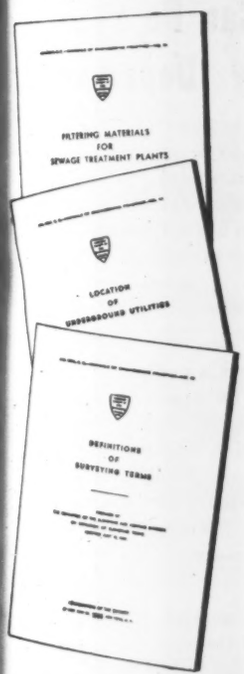

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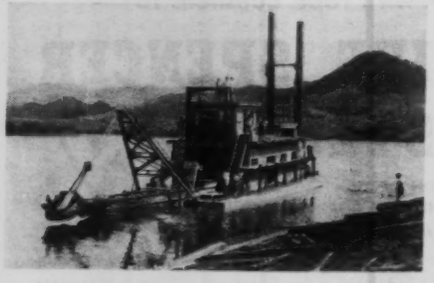
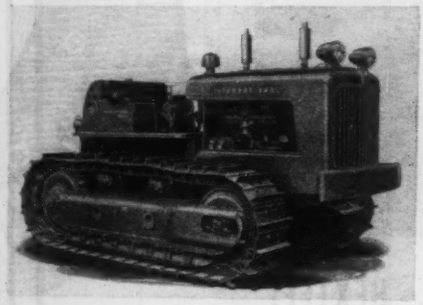


New International Tractor

A NEW DIESEL CRAWLER tractor in the 130 drawbar horsepower range is announced by International Harvester. This latest addition to the International Industrial Power line, the TD-24, weighs approximately 35,000 lb and is the largest tractor ever built by the company.



Features of the new tractor disclosed by the company include a new type of steering, giving the operator easy and positive control of the tractor; use of special sealing and anti-friction bearings in track rollers, greatly extending the track roller lubrication period; and convenient mounting for all types of allied equipment. The TD-24 is functionally streamlined, giving the operator a clear view of mounted equipment and the work in all directions.

The TD-24 is designed with a horsepower-to-weight balance which insures a high percentage of engine horsepower delivered at the drawbar. Eight speeds, from 1.6 to 7.8 mph, give the big tractor great flexibility on all jobs. This wide speed range, plus fast, easy gear changing, speed up round trip time cycles.

A new International six-cylinder, full-diesel engine powers the TD-24. This engine will have the International built-in gasoline starting system which, together with an electric starter, assures easy starting in all weather conditions. The TD-24 engine has many features which are standard on current International diesels, such as replaceable hardened cylinder sleeves, full pressure lubrications, Tocco hardened crankshaft, large diameter precision main and connecting rod bearings.

Production of the TD-24 will be a function of International's new Melrose Park Works, which has more than two million square feet of floor space. Since the plant will not be ready for use until the latter part of the year, it will be some time before the TD-24 will be available for sale.

New Muller Mixer

A NEW 3 S TILTING Concrete Mixer has just been introduced by the Muller Machinery Co., Inc., Metuchen, N.J.

The machine is furnished with either pneumatically tired wheels with Timken Bearings or steel wheels, and is equipped with Briggs-Stratton engine, all-steel drum bowl and a telescoping towing bail.

It has a mixing capacity of 3 cu ft of mixed concrete ($\frac{1}{2}$ bag up to 1–$2\frac{1}{2}$–5 mix). A bulletin illustrating and describing the machine is available.

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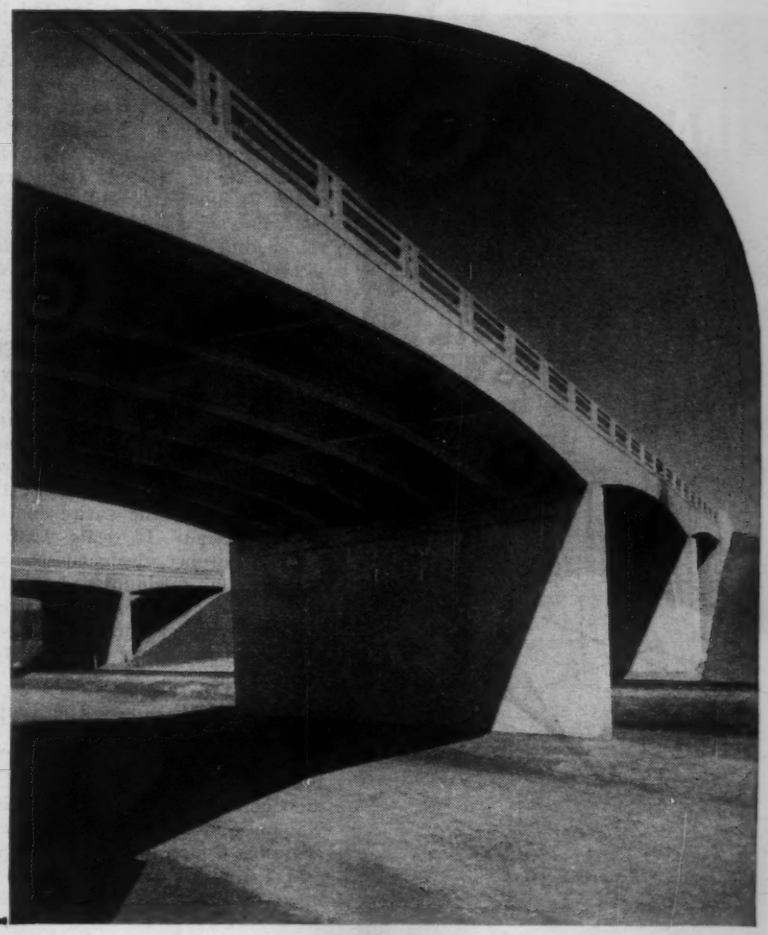

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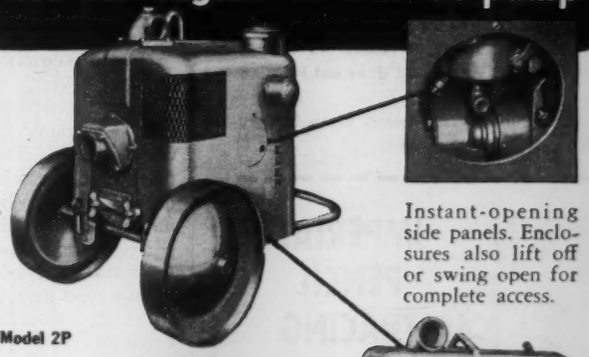

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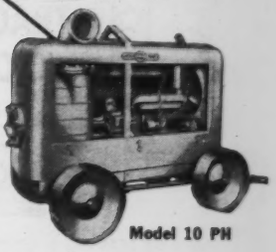

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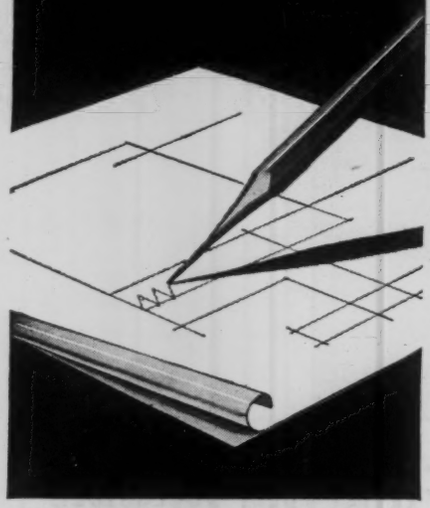

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ARC WELDING ACCESSORIES—An up-to-date price list and catalogue of Airco arc welding accessories is a 12-page booklet, Catalogue No. 130 which may be obtained from Air Reduction, 60 East 42nd St., New York, 17, N.Y., or the nearest Airco office. It illustrates and describes a complete line of accessories for all types of arc welding machines and operations. A section is devoted to Airco Heliwelding equipment for welding magnesium.

CENTRAL HEATING—The Ric-will Company, Union Commerce Bldg., Cleveland, Ohio, has issued a project study entitled "Looking Ahead to the Airport Center of Tomorrow." The purpose of this study is to present the case for central heating at a modern airport center and to demonstrate how the application of this principle can affect the entire conception of airport design. It deals with a hypothetical airport designed to serve the hundreds of medium and smaller sized cities in the country, which at present do not have within themselves the population to support their own terminals for scheduled airline stops.

CONCRETE FLOORS—The simplicity of building good concrete floors is concisely presented in a 12-page bulletin, "Concrete Floors with Lone Star Cement." Common construction faults are pointed out. The bulletin is divided into three sections, covering Concrete Floors, Specifications, and Incor Advantages. Lone Star Cement Corporation, 342 Madison Ave., New York 17, N.Y.

CONCRETE PAVING SPREADER—Twelve exclusive features of the latest Blaw-Knox concrete paving spreader are described in detail in a booklet, Catalogue No. 2046, which may be obtained by writing the Advertising Department, Blaw-Knox Company, Pittsburgh, Pa. The Blaw-Knox concrete paving spreader has been used on many roadbuilding and airport projects in this country, in many foreign countries, and was extensively used in the construction of air bases for the war.

HORTONSPHERES—Publication of a new 6-page booklet, "The Hortonsphere," has been announced by the Chicago Bridge & Iron Company, 332 S. Michigan Ave., Chicago, Ill. The booklet describes the reduction of evaporation losses from highly volatile liquids by storing them under pressure in Hortonspheres. The correct storage pressure required to prevent standing losses from volatile liquids can be read directly from the chart shown in this booklet. Included is a standard capacity table showing the operating pressures available for each size. Gaging methods are described and photographs of three typical gaging units are shown.

NICKEL ALLOYS—Revised List "A" of current publications on Nickel Alloy Steels, Nickel Cast Irons, Nickel Brass and Bronzes, and Nickel Plating is now available. Publications offered cover the production, fabrication, properties, and uses of Nickel Alloys for industrial applications, and the production, properties, and use of Nickel electrodeposits. International Nickel Company, Inc., 67 Wall St., New York 5, N.Y.

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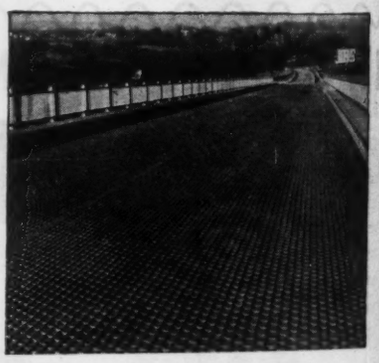

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